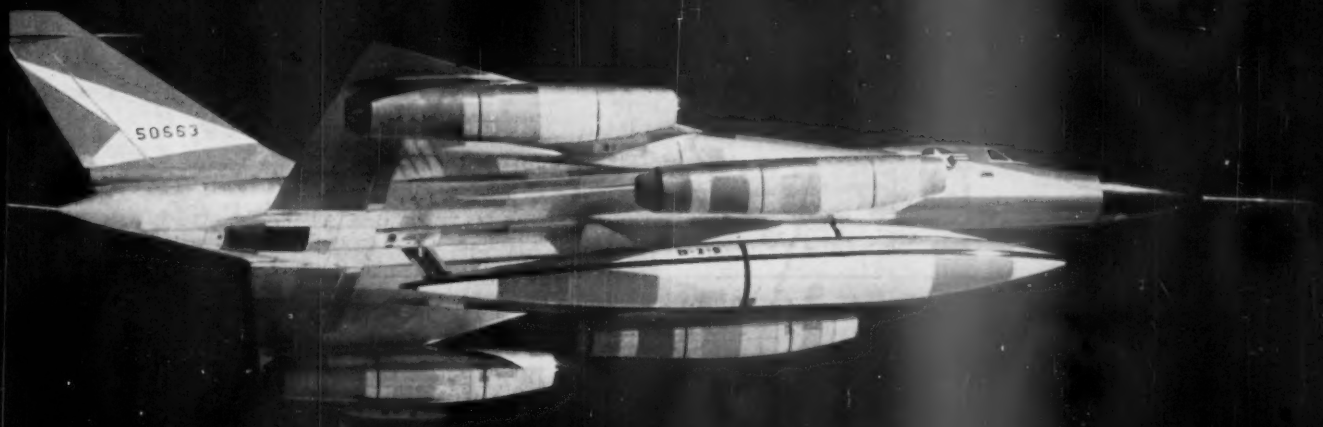
Aviation Week
and Space Technology

February 6, 1961

North American Studies Market For Civil T-39

Convair B-58
With Two-Component Pod



ANOTHER ASPECT OF THE MARQUARDT MISSION

LIFE SUPPORT IN SPACE –

An Independent Research Project by The Marquardt Corporation

Man now lives in an environment to which he has adapted himself and which to some extent has learned to control. Thus, the manned space exploration program on the verge of becoming a reality must eventually provide a closed ecological system—an earth-oriented, miniature world—so astronauts can survive, function and fulfill their missions in the hostile environs of deep space.

ASTRO, Marquardt's division for research into the space age, is actively engaged in an extensive Bioastronautics program of applied research to solve many of these physiological and psychological problems.

One basic physiological project is directed towards photosynthetic gas exchangers. Various algae forms are being used to effect the conversion of carbon dioxide to life-sustaining oxygen and food for the duration of the space voyage—a period that may last from a few weeks to a few years.

The creation of a capsule-sized ecological system to sustain man in space, only one of the many objectives of the independent research program underway at ASTRO, serves to typify yet another aspect of The Marquardt Mission.

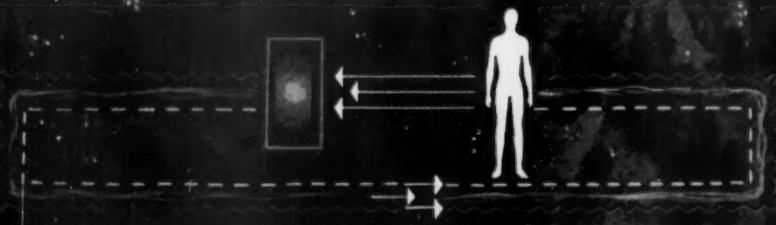
Creative engineers and scientists are needed.

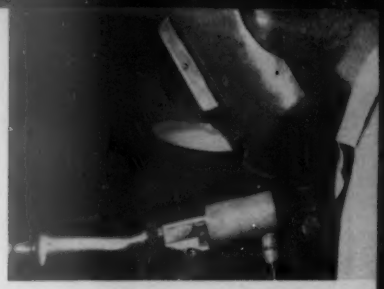
ASTRO DIVISION

THE Marquardt CORPORATION

CORPORATE OFFICES, VAN NUYS, CALIFORNIA

◆ ASTRO ◆ OGDEN DIVISION ◆ POMONA DIVISION ◆ POWER SYSTEMS GROUP ◆





Extremely high temperature material problems encountered on reentry into earth's atmosphere are studied with the aid of a plasma jet capable of 30,000°F.

Basic effects of elevated temperatures on various materials are viewed and photographed with the hot stage microscope.

CAPABILITY is spelled

r-e-s-e-a-r-c-h

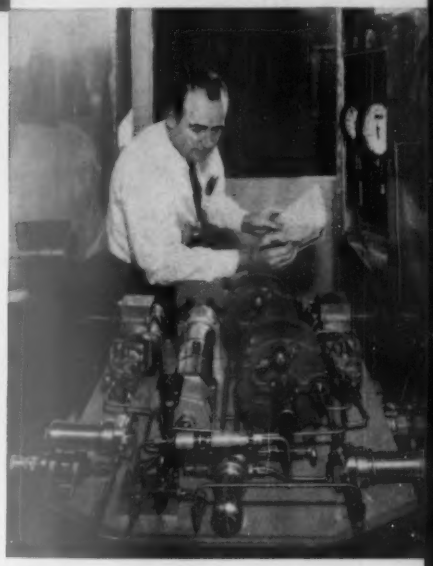
In technology and facility, Vickers continually matches your needs

New fluid power and hot gas systems for aerospace vehicles still in the idea stages are being developed at Vickers. Techniques for converting basic energy into precisely controlled power are continuously being sought by experienced teams of research specialists utilizing the finest scientific equipment.

Creative application of the sciences of hydrodynamics, aerothermodynamics, heat transfer, metallurgy and chemistry have been productively blended with Vickers vast experience in the instrumentation and control fields.

The principal effort of Vickers applied research is now concentrated in three areas: 1. advanced systems and components for attitude controls, 2. secondary rocket nozzle injection and 3. hot gas servo actuation. In addition, continuous refinements are being made to the high performance Vickers hydraulic pumps and motors.

The experienced Vickers Application Engineer in your area will welcome the opportunity to fill you in on additional details. In the meantime, write or call for Bulletin A-6002.



Advanced type of primary and emergency fluid power supply system developed and built by Vickers being readied for feasibility test in an environmental chamber.

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Analyses of fluids, propellants and special coolants for electronic equipment is carried out in completely equipped chemistry laboratory.

Analog computer (shown) and solid state Univac digital computer give Vickers the important edge in solving complex engineering problems.

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fluorosilicone rubber

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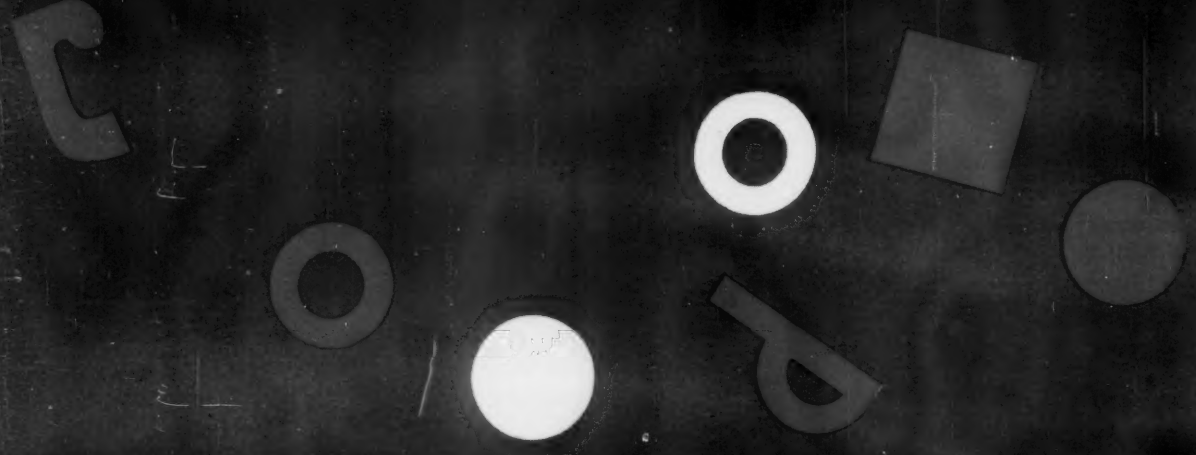

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Dow Corning CORPORATION
MIDLAND, MICHIGAN

AVIATION CALENDAR

Feb. 14-16—Second Annual Symposium on Non-destructive Testing of Aircraft and Missile Components (unclassified), Society for Non-destructive Testing and Southwest Research Institute, Gunter Hotel, San Antonio, Tex.

Feb. 15-17—International Solid-State Circuits Conference, Institute of Radio Engineers, Sheraton Hotel, Philadelphia.

Feb. 16-17—Symposium on Recent Developments in Materials for Nuclear Applications, University of New Mexico, Albuquerque, N. M.

Feb. 26-28—Texas Agricultural Aviation Conference, Texas A & M College, College Station, Tex.

Mar. 5-9—Sixth Annual Gas Turbine Conference and Exhibit, American Society of Mechanical Engineers, Shoreham Hotel, Washington, D. C.

Mar. 9-10—Second Symposium on Engineering Aspects of Magnetohydrodynamics, University of Pennsylvania, Philadelphia.

Mar. 9-10—Flight Propulsion Meeting, Institute of the Aeronautical Sciences, Cleveland, Ohio (classified).

Mar. 12-16—Aviation Conference, American Society of Mechanical Engineers, Statler-Hilton, Los Angeles, Calif.

Mar. 13-16—Missile and Space Vehicle Testing Conference, American Rocket Society, Biltmore Hotel, Los Angeles, Calif.

Mar. 16-18—Fifth National Conference on Aviation/Space Education, Mayflower Hotel, Washington, D. C.

Mar. 20-23—International Convention, Institute of Radio Engineers, Coliseum and Waldorf Astoria Hotel, New York, N. Y.

Mar. 20-24—1961 Western Metal Exposi-

(*Continued on page 6*)

AVIATION WEEK and Space Technology

February 6, 1961
Vol. 74, No. 6

Published weekly with an additional issue in December by McGraw-Hill Publishing Company, James H. McGraw (1860-1948), Founder. See panel below for directions regarding subscription or change of address. **Executive, Editorial, Circulation and Advertising Offices: McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y.** Printed at Albany N. Y. OFFICERS OF THE PUBLICATIONS DIVISION: Nelson L. Bond, President; Shelton Fisher, Wallace F. Traendly, Senior Vice Presidents; John R. Callaham, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; A. R. Venezian, Vice President and Circulation Coordinator. OFFICERS OF THE CORPORATION: Donald C. McGraw, President; Joseph A. Gerardi, Hugh J. Kelly, Harry L. Waddell, Executive Vice Presidents; L. Keith Goodrich, Vice President and Treasurer; John J. Cooke, Secretary.

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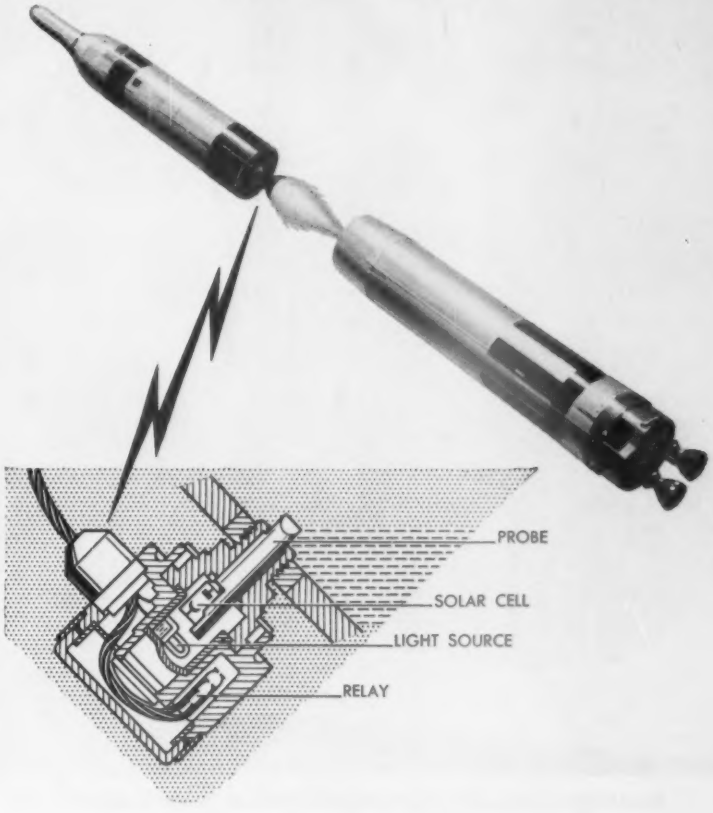
BENDIX OPTICAL LIQUID SENSOR SCORES 100% RELIABILITY ON TITAN I ICBM



When Titan I's fuel and oxidizer supply reaches a predetermined critically low point, the Bendix* Optical Liquid Sensor automatically shuts off the entire fuel supply, assures positive cessation of thrust, and starts stage separation sequence. In actual firings—with up to eight sensors on each missile—every sensor has operated perfectly.

The simple design of the sensor "package," which includes light source, probe, solar cell, amplifier, and relay, illustrates how Bendix research and experience solve propellant utilization problems. For details on what Bendix capabilities can mean to you, write today.

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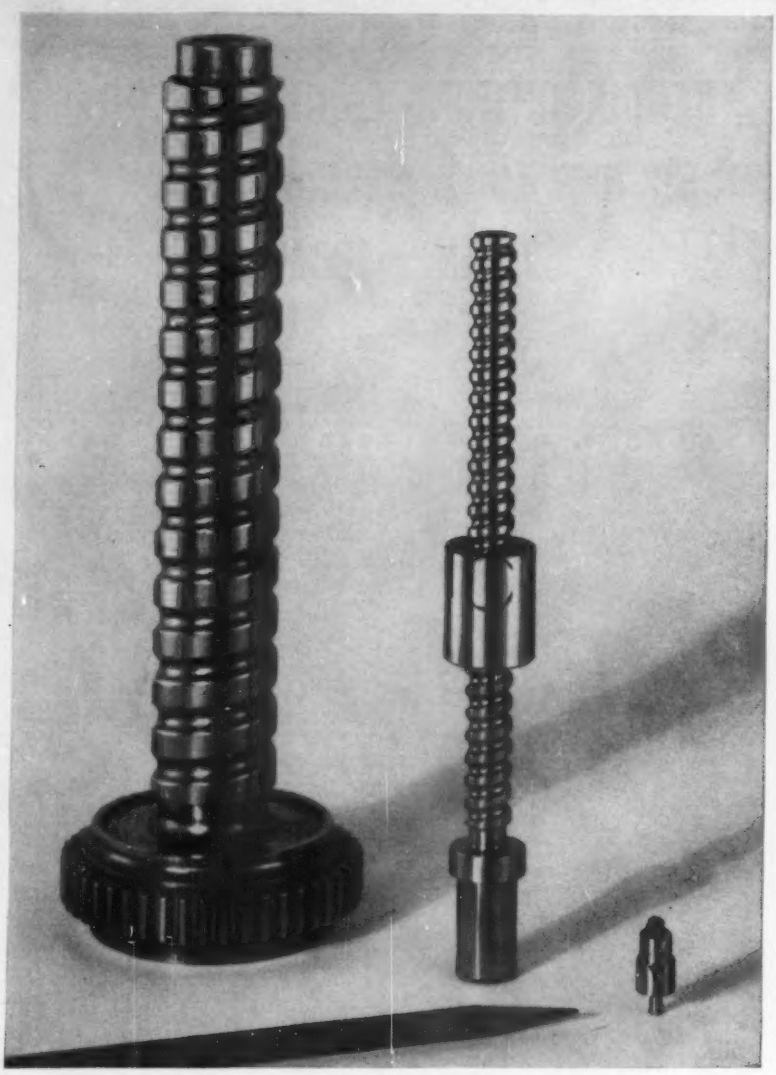

Kidde Ballscrews now in production include these ranges:

SIZES—3/16 to 1¼ inches (dia.), 19/32 to 8 inches (thread length).

WORKING LOAD—30 to 2000 lbs.

TEMPERATURE—minus 65°F to plus 840°F.

PRECISION—lead error of 0.0003 inch/ft.

Kidde ballscrews have a minimum amount of backlash and friction, perform functions demanding rapid reversibility of heavy loads. These abilities make them suitable for an extremely wide variety of applications in aircraft, missiles, and ground support equipment, including their use in aerodynamic surface controls, steering mechanisms, nuclear scram rod controls, and radar scanning drives. For more information ask for Brochure A-28.

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AVIATION CALENDAR

(Continued from page 5)

tion, American Society for Metals, Pan-Pacific Auditorium, Los Angeles, Calif.

Mar. 27-31—1961 Symposium on Temperature, Its Measurement and Control in Science and Industry, Columbus, Ohio. For information: V. W. Sikora, ISA, 313 Sixth Ave., Pittsburgh 22, Pa.

Mar. 28-29—Nucleonics in Flight Symposium, American Nuclear Society, Statler-Hilton Hotel, Dallas, Tex.

Apr. 4-5—Aviation Technician School Administrators Conference, Purdue University, Lafayette, Ind.

Apr. 4-6—International Symposium on Electromagnetics and Fluid Dynamics of Gaseous Plasma, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

Apr. 4-6—Lifting Re-entry Vehicles: Structures, Materials & Design, American Rocket Society, Palm Springs, Calif.

Apr. 4-7—National Aeronautic Meeting, Society of Automotive Engineers, Commodore Hotel, New York, N. Y.

Apr. 10-11—Spring Meeting, Western States Section/The Combustion Institute, Aeronutronic Division of Ford Motor Co., Newport Beach, Calif.

Apr. 13-14—Institute of the Aerospace Sciences/Army Aviation Meeting (classified), Washington, D. C.

Apr. 17-28—14th Technical Conference, International Air Transport Assn., Queen Elizabeth Hotel, Montreal, Canada.

Apr. 18-20—Symposium on Chemical Reactions in the Lower and Upper Atmosphere, Stanford Research Institute, Mark Hopkins Hotel, San Francisco, Calif.

Apr. 20-22—General Meeting, American Meteorological Society with the American Geophysical Union, Washington, D. C.

Apr. 22-25—Annual Business Meeting and Conference, American Assn. of Airport Executives, Broadmoor Hotel, Colorado Springs, Colo.

Apr. 26-28—Liquid Rockets, Propellants and Combustion Conference, American Rocket Society, Palm Beach Biltmore, Palm Beach, Fla.

Apr. 30-May 4—Seventh National Aero-Space Instrumentation Symposium, Instrument Society of America, Adolphus Hotel, Houston, Tex.

May 8-10—National Aeronautical Electronics Conference, IRE, Miami and Biltmore Hotels, Dayton, Ohio.

May 9-11—Western Joint Computer Conference and Exhibit, Ambassador Hotel, Los Angeles, Calif.

May 12-14—Mid-American Air Fair, Municipal Airport, Wichita, Kan.

May 15-17—National Symposium on Microwave Theory and Techniques, IRE, Sheraton Park Hotel, Washington, D. C.

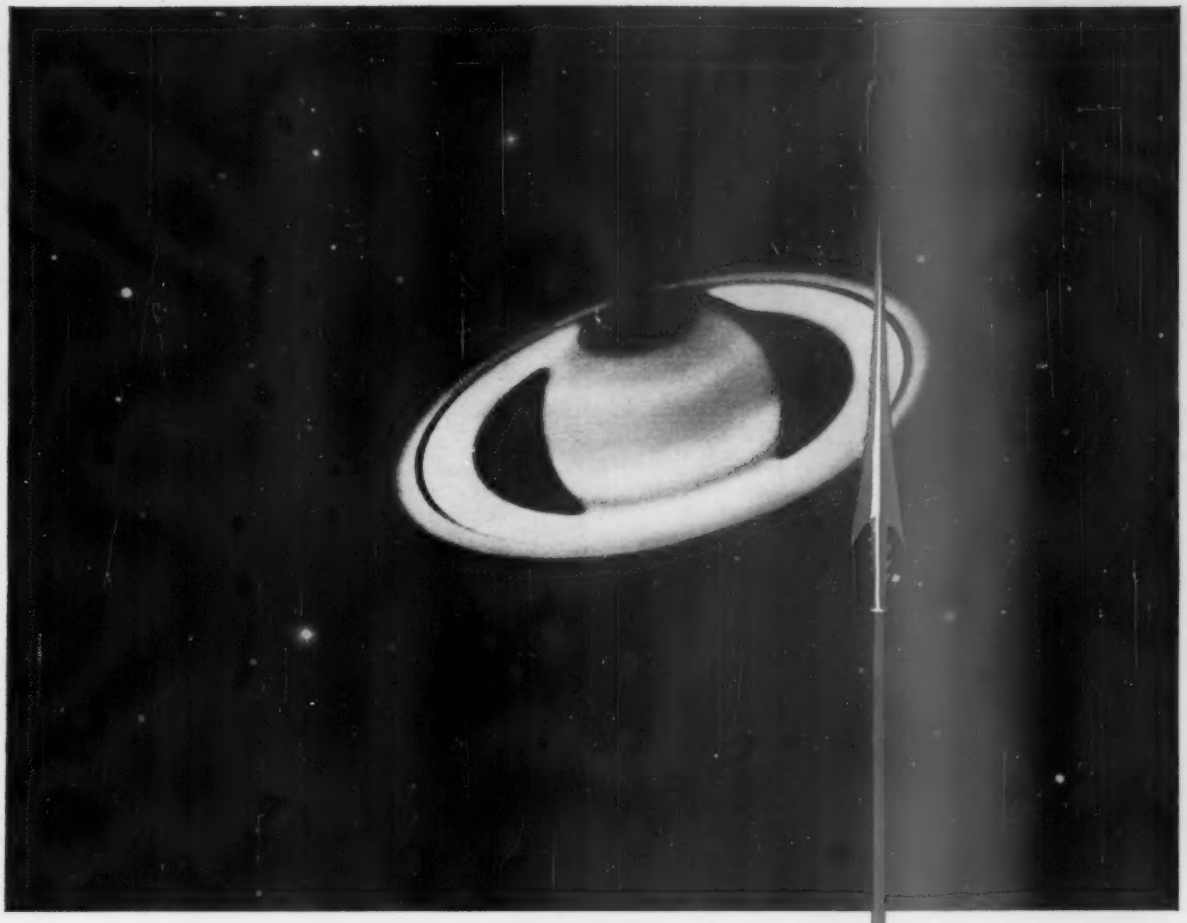
May 15-18—20th Annual National Conference, Society of Aeronautical Weight Engineers, Sheraton Hotel, Akron, Ohio.

May 22-24—National Telemetering Conference, Sheraton-Towers Hotel, Chicago, Ill.

May 22-24—Fifth National Symposium on Global Communications, Institute of Radio Engineers, Hotel Sherman, Chicago.

May 26-June 4—24th French International Air Show, Le Bourget, Paris, France.

Sept. 4-10—1961 Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.



SPEARHEAD INTO SPACE Created by Aerolab, the ARGO D-4 four-stage sounding rocket is now being used by NASA for the low-cost acquisition of important data at high altitudes and velocities. A wholly-owned subsidiary of Ryan Aeronautical Company, **Aerolab has developed more space probes and rocket-powered research models, including the Mercury capsule model, which have been fired, than any other firm in the United States.** Aerolab is a science team with quick reaction capabilities—a group of scientists and engineers with special talents for solving advanced problems in astrophysics, aerophysics and geophysics. Thus Aerolab's capabilities are added to Ryan's own in accomplishing breakthroughs in many vital areas of Space technology.

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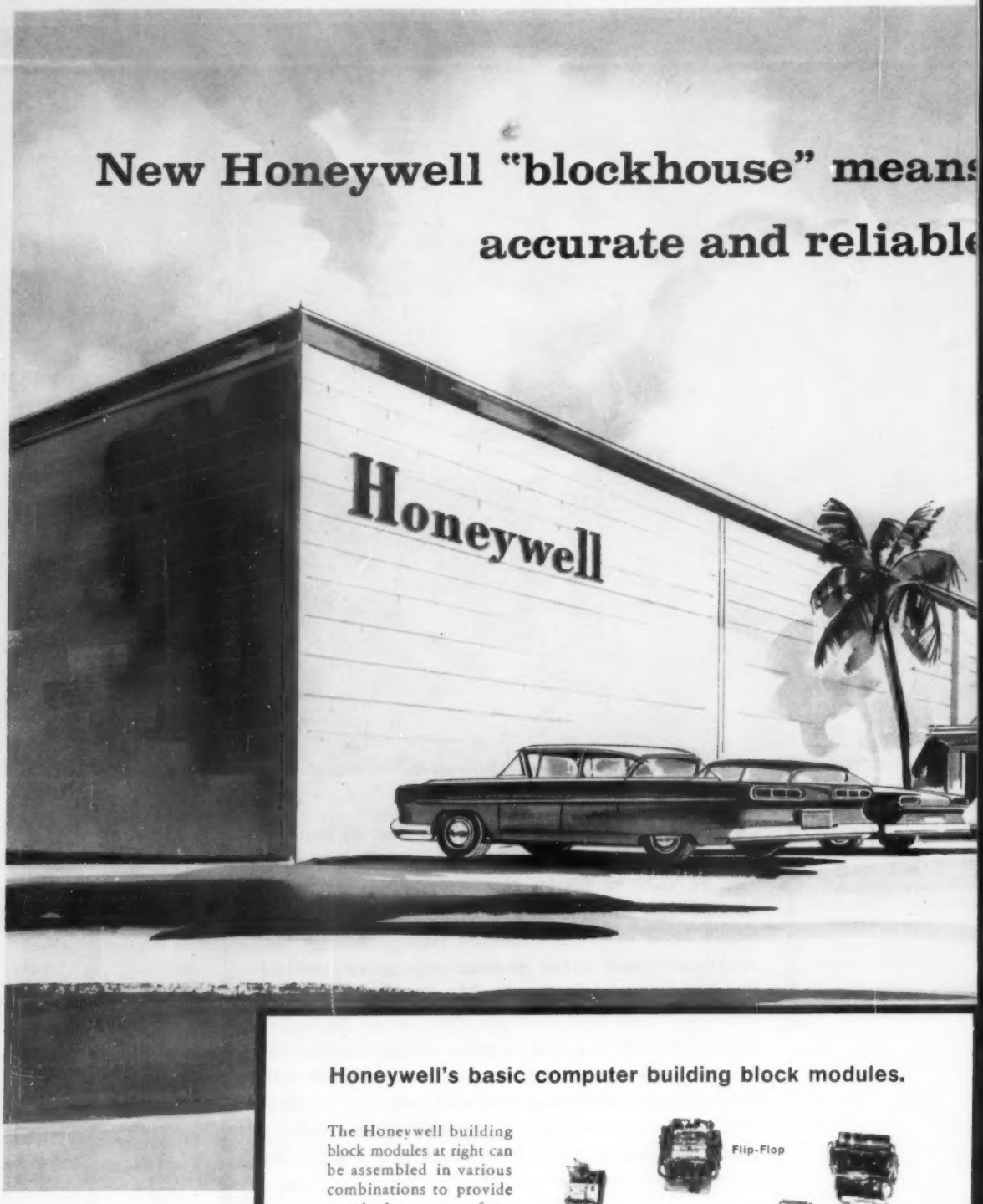
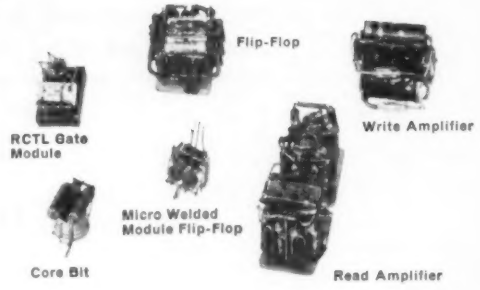
Ryan Aerolab offers challenging opportunities to engineers

New Honeywell "blockhouse" means accurate and reliable



Honeywell's basic computer building block modules.

The Honeywell building block modules at right can be assembled in various combinations to provide exactly the computer functions required. Building block construction from on-the-shelf modules assures wider flexibility, greater reliability, faster delivery and lower cost.



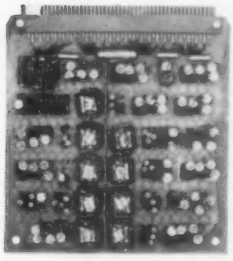
more computers!

New computer "blockhouse" houses Honeywell's expanding inertial guidance computer programs. Located in St. Petersburg, Florida, the building adds to Honeywell's main St. Petersburg facility (shown in background). This is the only facility in the world built specifically for the design and development of inertial guidance systems.

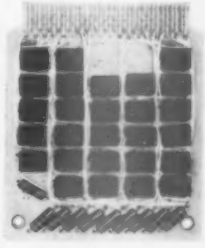
Honeywell's new computer building provides the most perfect environment possible for the development of more accurate and reliable inertial grade computers.

Within this new blockhouse, Honeywell now has under test or in production two advanced types of General Purpose Computers and two Incremental Computers. Three of these new computers are especially designed around Honeywell's new standard welded module computer building blocks. This welded module construction permits a high degree of miniaturization. Standard Flip-Flop module packing density, for example, is greater than 100,000 components per cubic foot. For the new Honeywell Micro Welded Module Flip-Flop, the packing density is 660,000 components per cubic foot.

These computer building blocks consist of two basic types of units —Aero-Space and Marine—as shown below.



AERO-SPACE UNIT



MARINE UNIT

To each of these units is added one of three Honeywell environmentally-suited memory drums shown. These drums feature:

- Up to 200 bits per inch
- 25 tracks per inch
- Multiple head assemblies for minimum adjustment
- T.I.R. Less than 50 millionths of an inch
- Head electrical characteristics compatible with solid state circuitry

2.5 inch rotor
56,520 bits

5 inch rotor
312,000 bits

8.56 inch rotor
161,200 bits

Honeywell has been developing a wide variety of Aero-Space and Marine Inertial Grade Computers since 1954. The company is fully qualified to develop and build environmental whole-number and/or incremental computers of an advanced nature to meet your special requirements. To learn how Honeywell can solve your inertial grade computer problems, contact your nearest Honeywell representative. Or write: Honeywell Aeronautical Division, Dept. AW-2-178, 13350 U. S. Highway 19, St. Petersburg, Florida.

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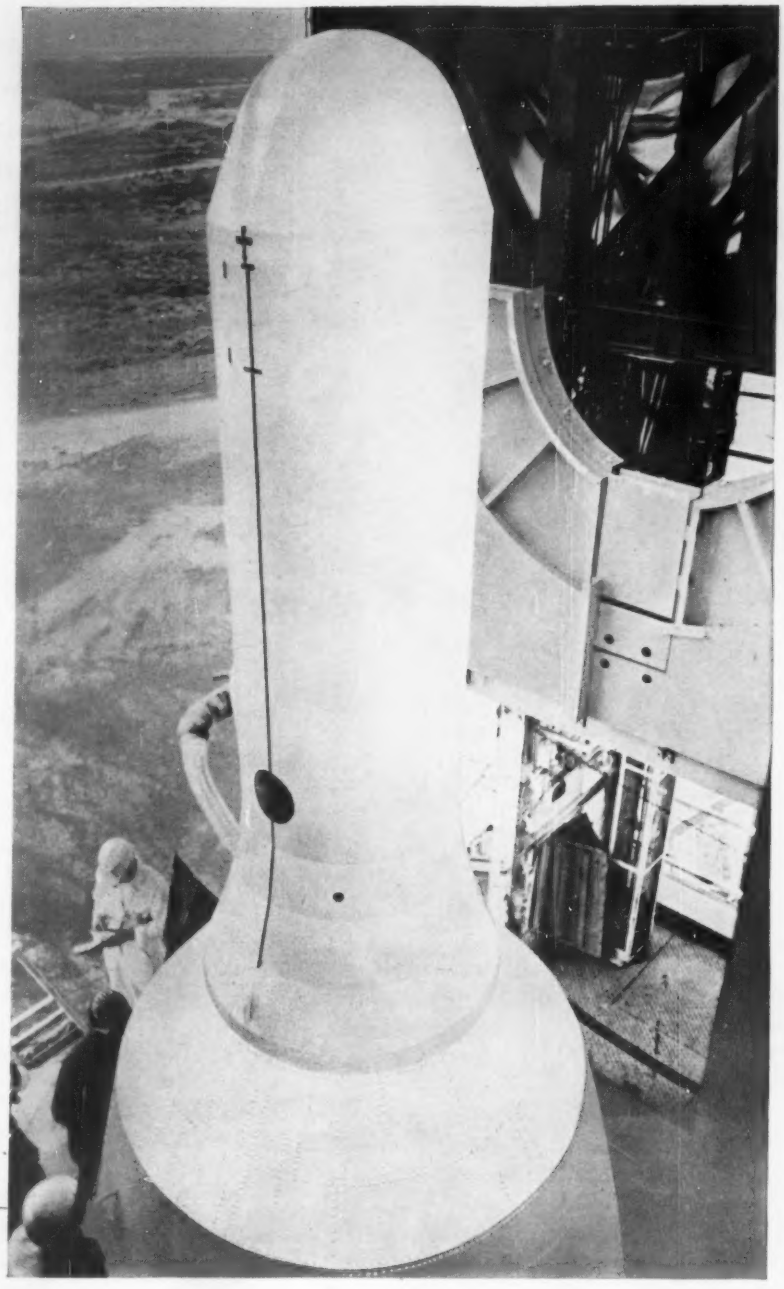

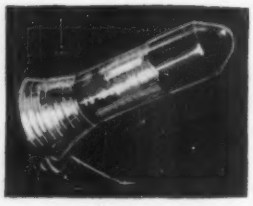

ABLATIVE MATERIALS ENABLE FIRST ICBM NOSE CONE RECOVERY
This RVX1-5 was the first nose cone to travel full ICBM range and be successfully recovered intact. Speeds up to 15,000 mph, temperatures to 12,000°F, high heat inputs, and high acceleration and deceleration forces were encountered. The RVX1-5 was enabled to withstand these severe re-entry conditions through the use of REFRASIL[1] and AVCOITE[2] ablative heat shield materials.

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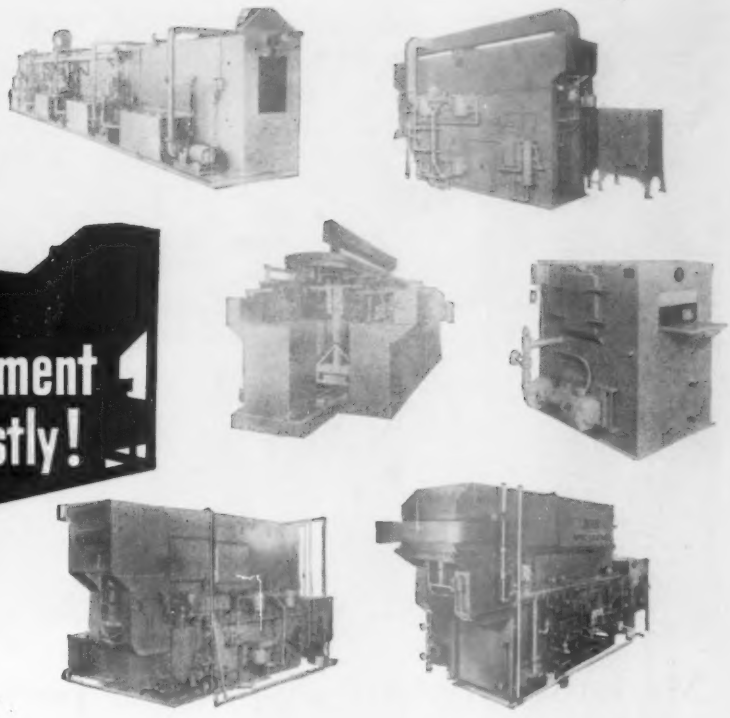
[1] *REFRASIL is a registered trade mark of H. I. THOMPSON FIBER GLASS CO.* [2] *AVCOITE is a registered trade mark of the AVCO CORPORATION.*



Detrex will lease a machine to fit your needs exactly and economically!

It is no accident that the Detrex nameplate is found on more cleaning equipment in more metal-working plants than any other—*by a wide margin.* Detrex has had more than 30 years' experience in designing this equipment—has the most complete and modern facilities for producing it—has the largest and most expert field force to help install and service it. And now you can lease any of your cleaning equipment requirements from Detrex. Whether you need a machine for degreasing, washing, rustproofing, phosphate coating, paint-bonding or paint stripping—whether you require equipment that is large or small—whether you desire a manual or automated operation—Detrex can supply your needs exactly and follow through with the service that means complete satisfaction.

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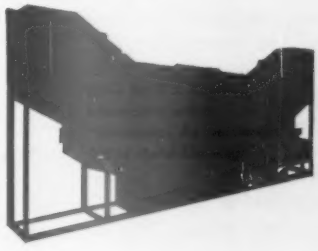
- Ultrasonic Equipment
- Industrial Washers
- Phosphate Coating Compounds
- PAINTBOND Compounds
- Aluminum Treating Compound
- Alkali and Emulsion Cleaners
- Rustproofing Materials
- Extrusion and Drawing Compounds
- Spray Booth Compounds



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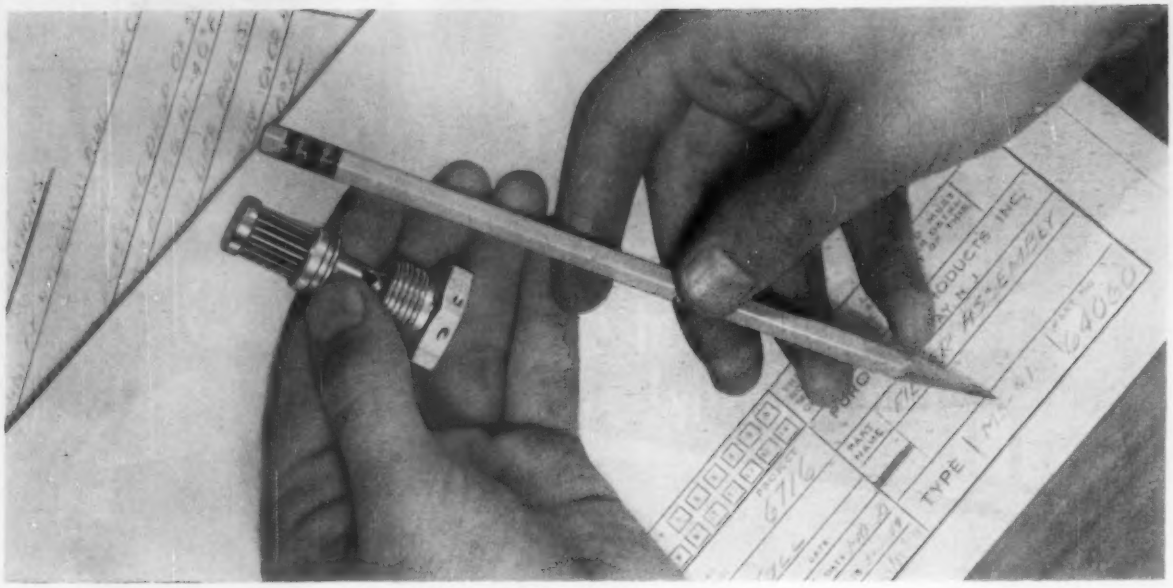

Miniaturized cavity-type filter packs 4.2 square inches of filtering area into 1" x 9/16" element

Purolator develops thumb-nail size element to protect hydraulic control circuits on Army's Hawk Missile mobile launcher.

How small can you make an element that must filter 2 gpm hydraulic oil at 2500 psi at any temperature within a 315° range? Purolator's new miniature cavity-type hydraulic filter is the best answer to date. Here's why:

4.2 square inches of convoluted stainless steel wire cloth are packed into this miniature filter. This element, which weighs 0.25 ounces, filters two gallons per minute of hydraulic oil, at temperatures ranging from —40° to + 275° F. The element will withstand 2500 psi differential pressure without collapsing.

The element is made up of a total of ⅛-mile of stainless steel wire, woven into wire cloth and convoluted to extend filtration area. This element will remove 98% of all particles whose two smallest dimensions are larger than 10 microns, and 100% of all particles measuring 25 microns or more.

The picture at the top of the page shows you the complete filter assembly, ready for installation in the hydraulic control system. The overall length of the unit is 2 1/32"; maximum overall diameter is 1". Total weight is slightly over 1 ounce. Designed as a cavity-type unit, the filter is installed simply by screwing it into the hydraulic system so the filter element intercepts oil flow. The element can be removed, cleaned and replaced without special tools.

The picture at right shows the mobile launching platform for the Hawk Missile. The compactness and mobility of the

launcher, and the probability that it would be subjected to severe jolting, made it necessary to specify as small a filter as possible, and one that could be integrated with the rest of the system for maximum simplicity and durability.

The Purolator engineers who developed this new miniature cavity-type filter are available now to design a filter to meet your specifications. Simply contact Purolator Products, Inc., Department 3096, Rahway, New Jersey.

Filtration for Every Known Fluid **PUROLATOR**

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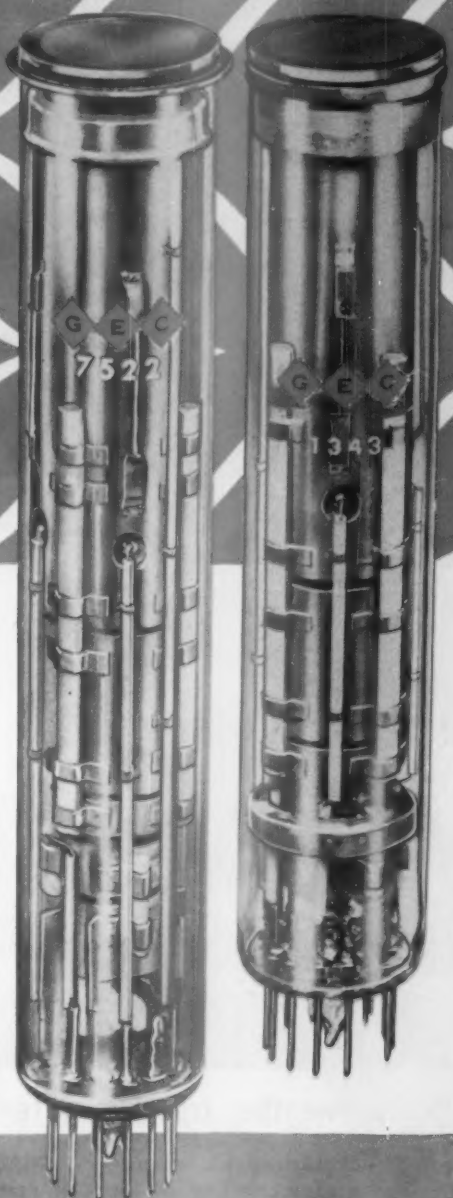

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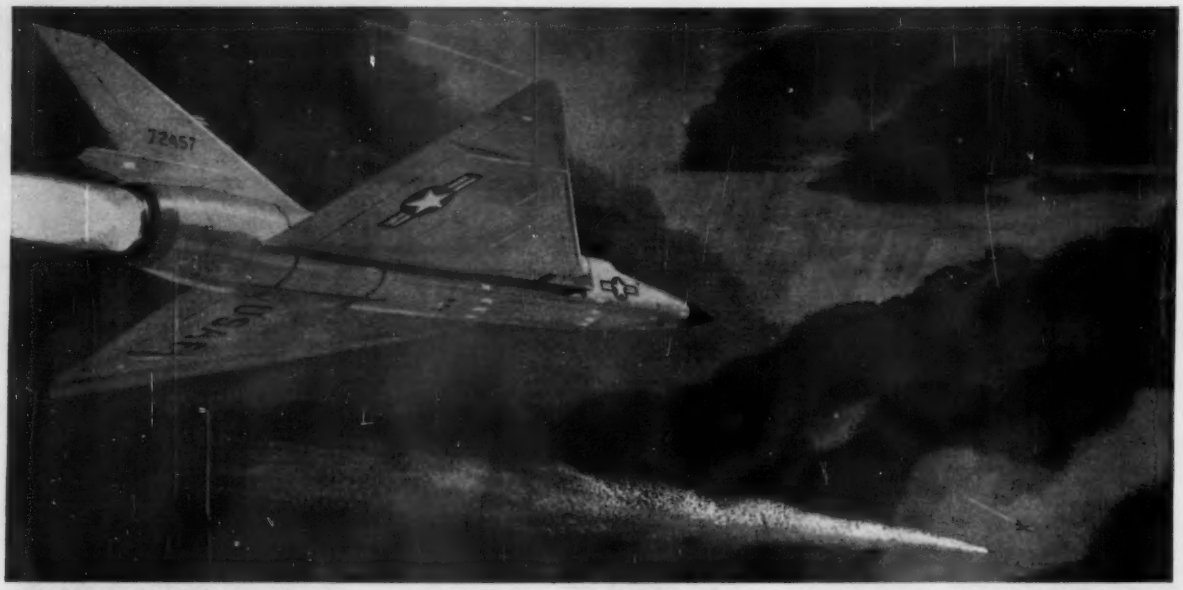

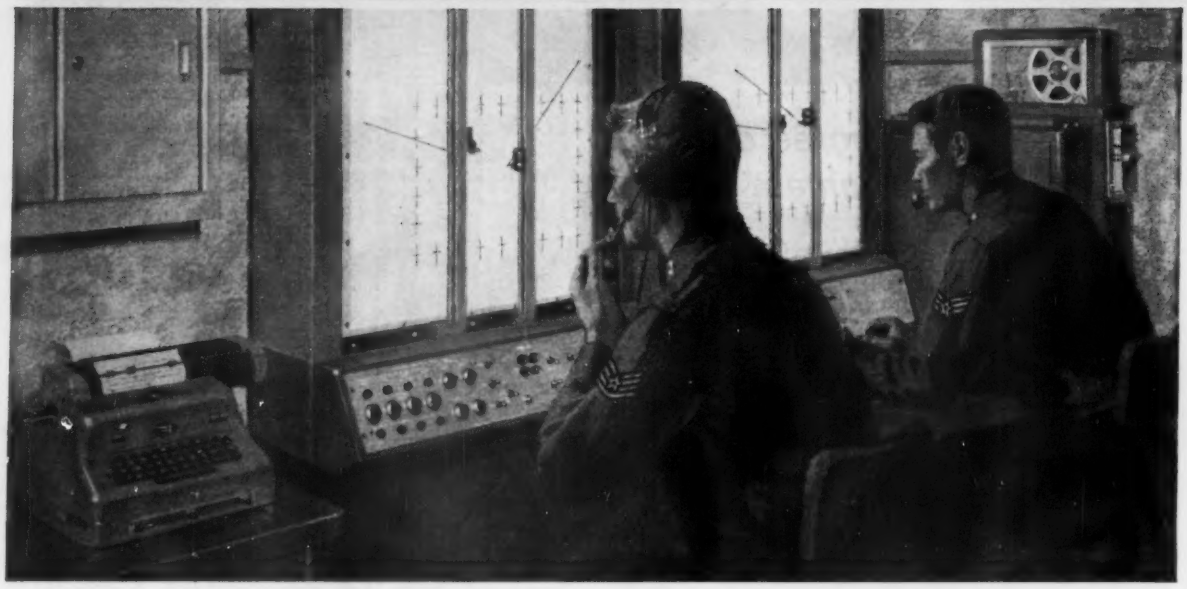

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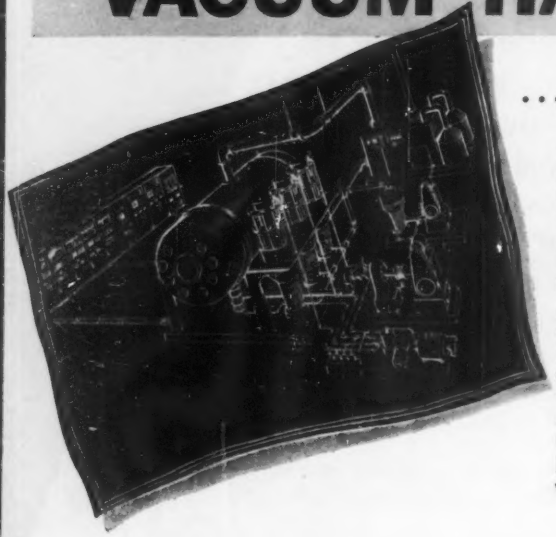

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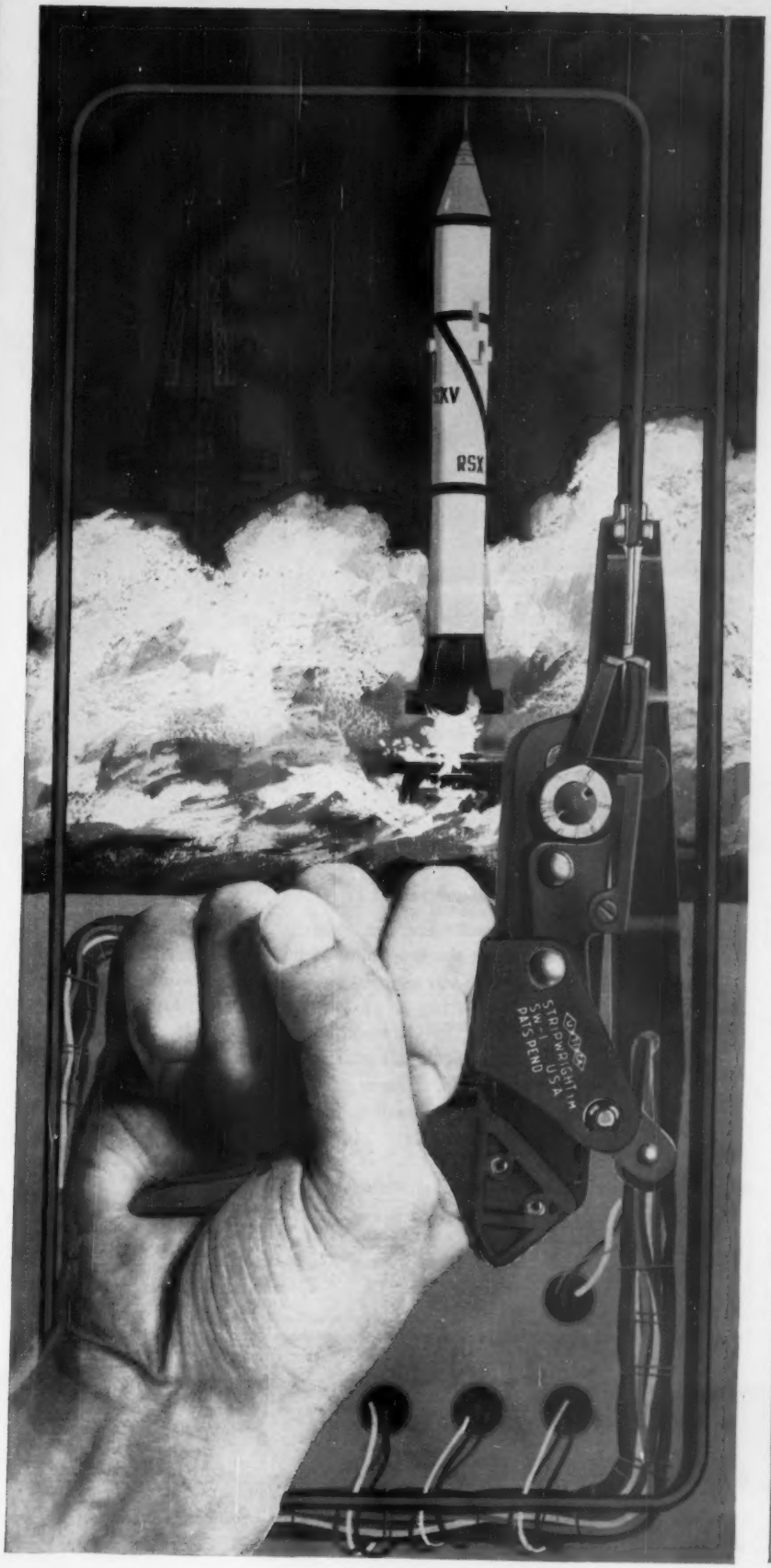

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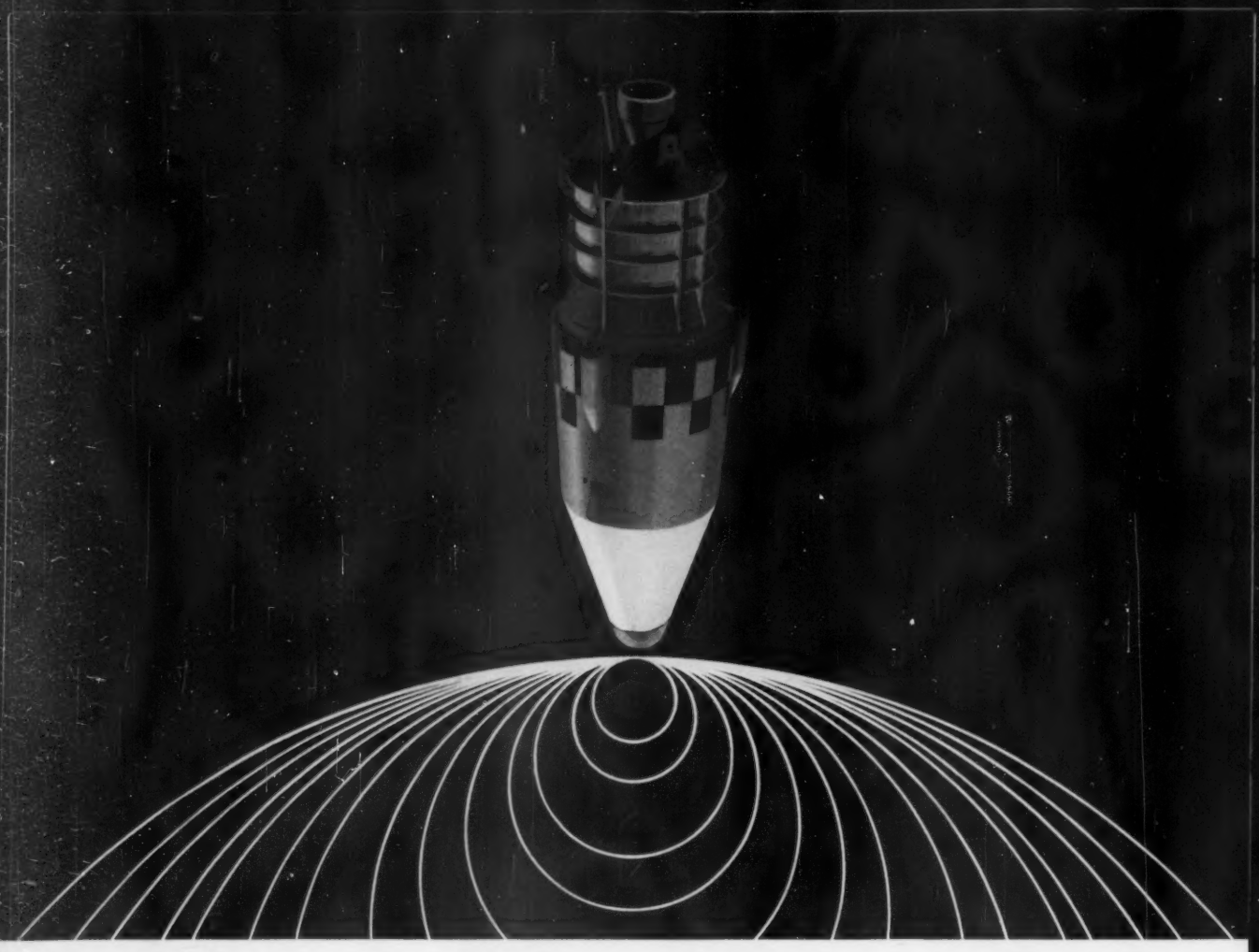

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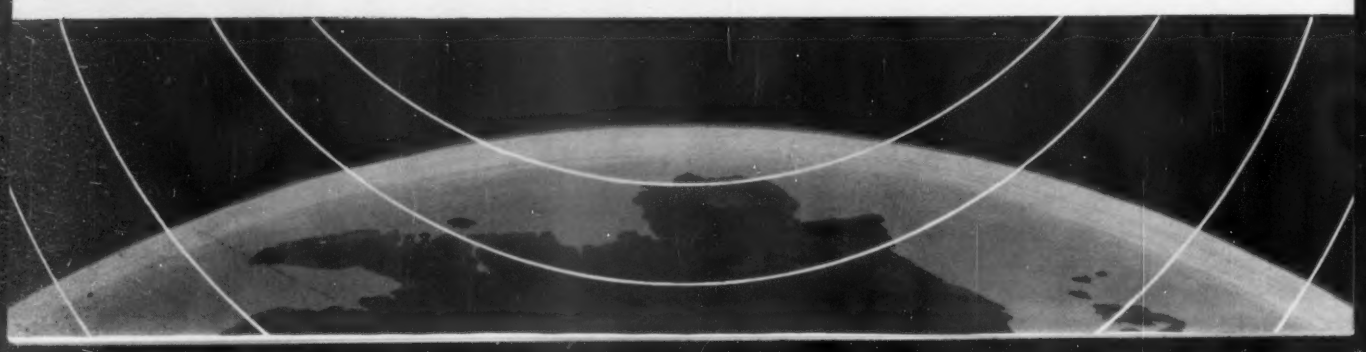

February 6, 1961

Aviation Week and Space Technology

Vol. 74, No. 6
Member ABP and ABC

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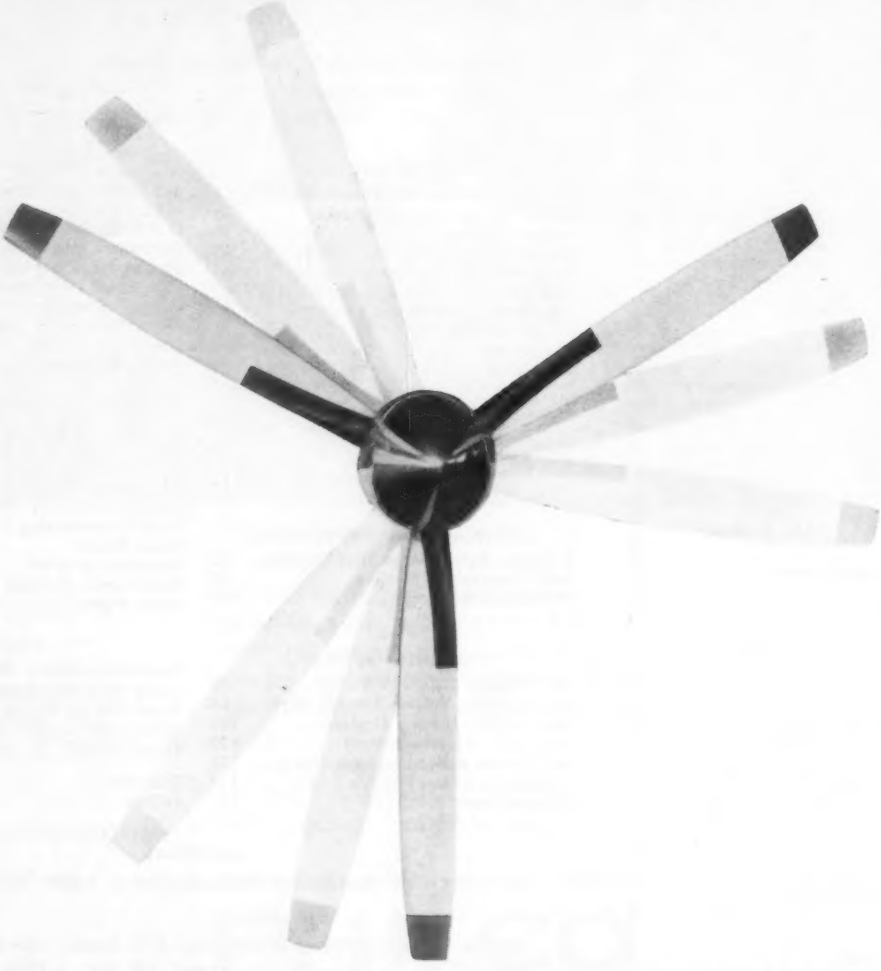

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EDITORIAL

Success and Disappointment in Space

Three major milestones were passed last week in space technology with the successful test of the Mercury capsule containing a chimpanzee, the remarkable three-stage operation of the first full-scale Minuteman firing and the precise performance of the Samos II reconnaissance satellite. They represent solid technical achievement in the development of three distinct phases of space technology, but they are still only milestones along a still difficult and expensive road to the operation of reliable space and missile systems. Although these three shots represent a rosy glow on the technical horizon, the day of operationally reliable missile and space systems has not yet dawned, and much work remains before it will.

Thus it is rather disheartening to many who read the recent Wiesner report to President Kennedy, blueprinting areas of improvement in the national space program and particularly in the National Aeronautics and Space Administration, to see some of its most pertinent advice disregarded. The Wiesner report urged providing a "vigorous, imaginative and technically competent top management for NASA" and further urged that in the selection of an administrator, particular attention should be paid to the "need to make space activities attractive to a larger group of competent scientists and engineers."

The selection of an NASA administrator who by his own admission knows nothing about space technology will hardly contribute much to either of these vital objectives. James Webb's record indicates he is an adroit politician, an able administrator and a man who enjoys juggling a great many occupations and commitments simultaneously. But it is difficult to find any qualifications in his long and distinguished record that qualify him as a leader in space technology.

As under secretary of state, however, he was one of the earliest government officials to recognize the post-war need for increased technical input into the decision-making machinery and was extremely successful in mobilizing top technical talent both for the Frontiers of Science Foundation and for high school science teaching programs he organized while in the oil business.

It is therefore not surprising if the theory is current that it is his political and business associations—particularly with Sen. Robert Kerr, now chairman of the Senate space committee—that were the dominant factors in picking him for the post. Sen. Kerr ascended to the space committee chairmanship through seniority rather than through any interest in space technology or the national space program. His attendance record at meetings of the Senate space committee during the last Congress was probably the worst in the group, and these appearances would not require all the fingers of one hand for tabulation.

The perfunctory questioning of Mr. Webb by Sen. Kerr's committee and the lack of any inquiry directed toward his qualifications for the NASA post before recommending confirmation will certainly lend support to this theory.

Thus, it is a little appalling to the technical community that is interested in space and found considerable hope in the Wiesner report to see a partnership of prior indifference to the subject assume such key roles at such a critical time in the development of space technology. It makes them wonder why the Kennedy Administration felt it necessary to appoint a nuclear physicist to head the Atomic Energy Commission and an experienced pilot to head the Federal Aviation Agency, and then accepted total ignorance of space technology as a qualification for the NASA administrator.

We seriously doubt if engineers and scientists will be attracted to the national space program in any great numbers by leadership composed of an Oklahoma oil senator and his business associate. And where will NASA get the four top technical directors for propulsion and vehicles, scientific programs, non-military space applications and aerodynamic and aircraft programs, as urged by the Wiesner report, with this type of top management?

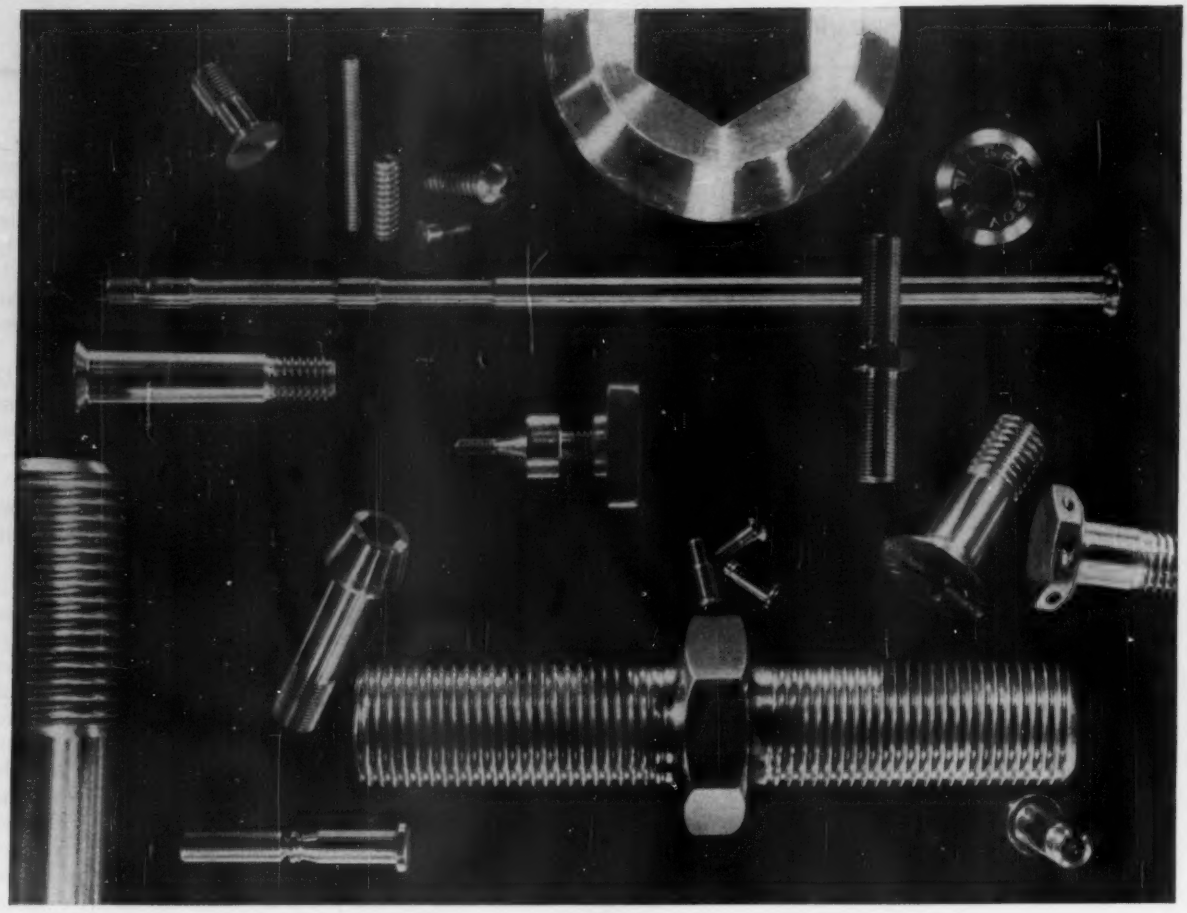
The Kennedy Administration, after a bright start in the fields of defense, nuclear energy and aviation, has dashed considerable cold water on the hopes of enthusiastic young technicians it might have attracted to broaden the base of its national space program. It will also give further credence to the rumors that have been floating around Washington for some months that the future role of NASA in the national space program will be diminished in relation to the total effort. Whether this is true or not, the selection of a nontechnical NASA administrator will make this feeling more difficult to dispel.

NASA already has suffered from the effects of having its top man picked primarily for administrative rather than technical ability. Keith Glennan's prior success in the academic world rested primarily on his ability as a fund raiser for his technical institute. He did a commendable job in defending the NASA budget against the White House infantry coterie who really believed that there was not a single iota of military or scientific significance in space and that money spent for this purpose was wastefully poured down a rathole. However, his dabbling in the detailed technical programs of NASA did them no good, nor was he ever able to stir much public or technical enthusiasm for the NASA program. This was due primarily to his lack of knowledge on the subject, which prevented him from performing as a very convincing spokesman on the subject either before the Congress or the public. Retention of Mr. Glennan, a lame duck NASA administrator, as a consultant to the Senate space committee must certainly puzzle the technical community working in space.

The Kennedy Administration should take another hard look at what it is doing in the area of space technology before this vital effort becomes so entangled in political ties that it cannot progress technically.

It may be possible to gloss over this type of operation in Congress, but it will be difficult to fool the technical community either in this country or abroad whose support is so vital to U.S. success in this field. And it certainly won't fool the Soviets, who will assess its significance shrewdly in terms of what they can and must do to maintain a world image of technical leadership.

—Robert Hotz



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O. D. Perry, president, Triad Transformer Corp., a division of Litton Industries, Venice, Calif., succeeding **L. W. Howard,** retiring. **A. E. Wahlgren** succeeds Mr. Perry as executive vice president.

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Robert L. Hirsch, assistant to the vice president, Aerojet-General Corp.'s Solid Rocket Plant, Sacramento, Calif.

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Following are the recipients of the Institute of the Aerospace Science's Honors and Awards for 1960: **American Fellowship—Charles J. McCarthy,** former board chairman of Chance Vought Aircraft, Inc.; **Foreign Fellowship—M. J. Lighthill,** Director of the Royal Aircraft Establishment, Farnborough; **Grover E. Bell Award—Combat Development Office, U. S. Army Aviation School,** Fort Rucker, Ala.; **Daniel Guggenheim Medal—Grover Loening,** aviation pioneer; **Louis W. Hill Space Transportation Award—S. K. Hoffman,** president, and

(*Continued on page 101*)

INDUSTRY OBSERVER

► Bendix Eagle missile system will be compatible with other aircraft, although it is designed primarily for the Douglas F6D Missileer which was cut from the Fiscal 1962 budget for economy reasons. Navy has bailed three Douglas A3Ds to Bendix for Eagle component and system flight tests. This attack aircraft could be modified to carry the missile, although it is larger than necessary.

► **West German air force is seriously considering the supersonic Northrop T-38 in its search for a high performance trainer to ease pilot transition into the Mach 2 Lockheed F-104 interceptor and subsonic Fiat G.91 close support aircraft. Most modern trainer in the present inventory is the Lockheed T-33.**

► Use of a Thor-based launch vehicle for ballistic ejection tests of the Rebound inflatable satellite is under consideration by National Aeronautics and Space Administration. Ejection test of the 140-ft. reflector satellite probably will be made from Atlantic Missile Range because NASA's Wallops Station lacks ground support equipment and pad facilities for large liquid fuel rockets.

► **Reduction of skin friction drag as much as 60% at Mach 5 has been achieved by injecting helium into the boundary layer. The technique was first suggested several years ago, and recent NASA tests have confirmed that theoretical reductions are possible. Concept could be applied to Dyna-Soar type vehicles to increase gliding range at hypersonic speeds.**

► Proposals for outfitting two ships as mobile Atlantic range stations (MARS) will be evaluated separately by Aerospace Corp., Pan American World Airways, which is Atlantic Missile Range operator, Lincoln Laboratories and USAF's Command and Control Development Division. High level Air Force board will choose a contractor from the four recommendations. Bids are expected from teams headed by Alpha Corp., Burroughs, Chance Vought, General Dynamics/Electronics, General Electric, Lockheed, Martin-Baltimore, Radio Corp. of America, Raytheon, Sperry Rand and Vitro Corp.

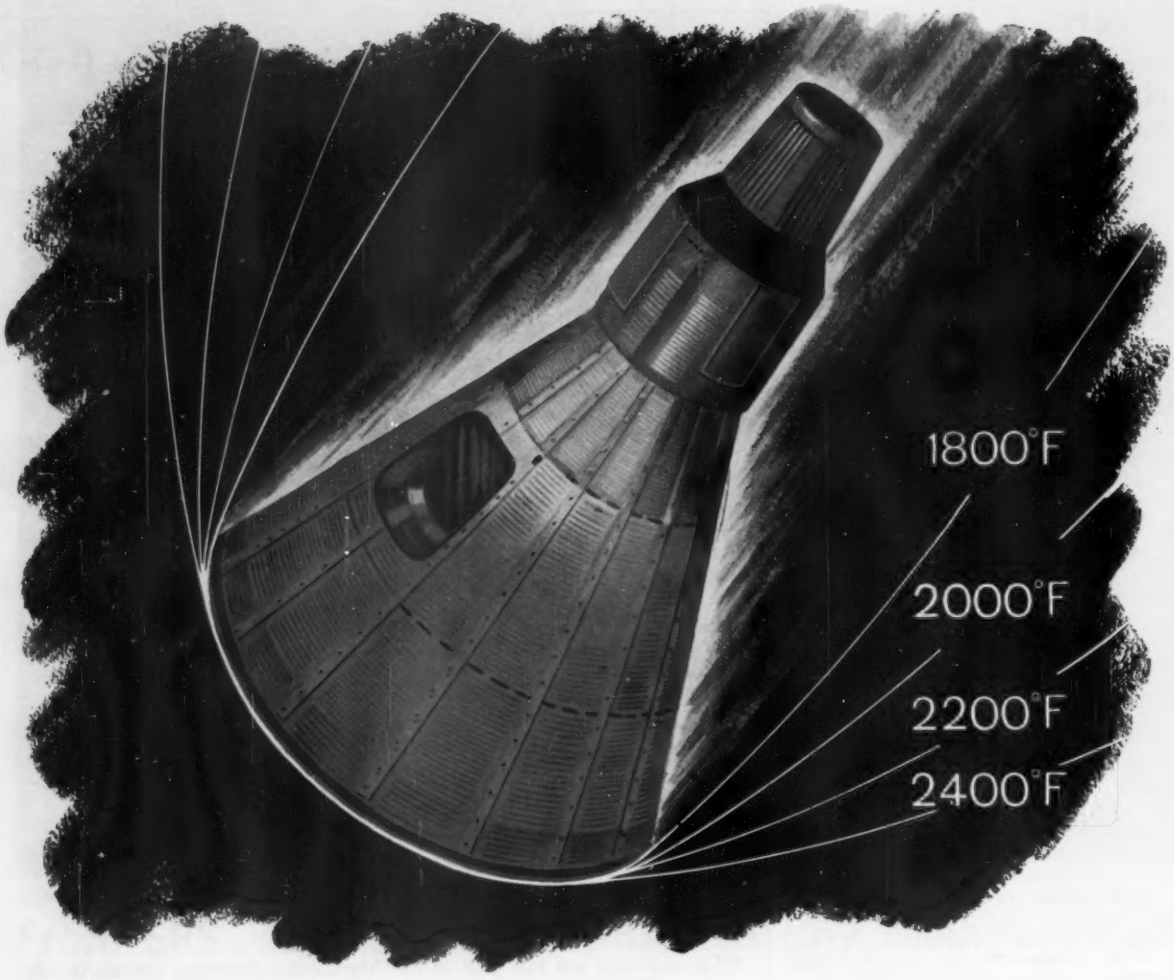
► **Ground runs and taxi tests of the Marvelette, prototype aircraft in Mississippi State University's Army-sponsored Marvel STOL program (AW Nov. 30, 1959, p. 59), are scheduled to begin this month. First flight is planned this summer. Allison T63 turbine engine for the Marvel is to be delivered this summer. This later aircraft in the program is to be ready for its first flight early next year.**

► Nominal altitude for orbital flight of the Mercury manned capsule has been lowered from 105-120 naut. mi. to 80-100 naut. mi. because calculations indicated that the retrorockets would land the capsule in Africa instead of the Atlantic Ocean if fired at the planned injection point in the higher altitude range. Launch teams now will attempt to hit an optimum altitude of 92 naut. mi. for the first orbital shots.

► **Bristol Siddeley is developing a 4,000-lb.-thrust aft fan version of the former Armstrong Siddeley Viper Mk. 11 turbojet for service in 1963. The turbofan could have a military application, but it probably is aimed at a twin-engine executive transport project de Havilland has under consideration.**

► Second attempt to launch a small inflatable sphere into orbit with a Scout vehicle is scheduled in six to eight weeks from NASA's Wallops Station. First Scout satellite launch attempt failed (AW Dec. 12, p. 33).

► **Future high speed underwater missiles may have parabolic bodies of revolution with blunt bases that will permit speeds as high as 300 kt. NASA tests of underwater shapes have shown that parabolic bodies can have low drag while operating at supercavitation speeds. In these conditions, the entire forebody would be wetted and the vapor-filled cavity would extend far enough aft that it would not impinge on the body and cause damage.**



When this Mercury falls—temperatures soar!

Project Mercury engineer, in an Astronaut's pressure suit, with prototype HAYNES alloy-clad space capsule.

Whirling into re-entry from outer space, NASA's Project Mercury manned orbital space capsules must face a violent temperature rise. To protect the rear body walls from the terrific heat—plus violent erosive forces of the air—two alloys, produced by Haynes Stellite Company, were among those selected by the capsule builder. Rolled into thin sheet, these alloys dissipate the frictional heat by radiation outward into space—even as they maintain ample structural strength and outwit erosive attack.

HAYNES alloys that resist temperatures of over 2000 deg. F.—for long periods and under great stress—today serve in many hot spots. Resistance to stress, thermal shock, erosion, corrosion, and fatigue makes these alloys extremely useful in jet engine turbine wheels, in ramjets, missiles, rockets, and manned space capsules.

Whether investment- or sand-cast, rolled, wrought, vacuum melted, or air melted, there's a HAYNES high-temperature alloy to meet your needs.

HAYNES
ALLOYS

HAYNES STELLITE COMPANY
Division of Union Carbide Corporation
Kokomo, Indiana

UNION CARBIDE

Address inquiries to Haynes Stellite Company
270 Park Avenue, New York 17, New York

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Washington Roundup

York Reorganizing

Dr. Herbert York is reorganizing his Office of Defense Research and Engineering to streamline it internally, place more emphasis on applied research and improve management of in-house and contractor programs.

He will have one deputy—John Rubel—instead of the three he has now, and five directors. A new director of applied research, who will be a top-level scientist, will direct the six technical offices—such as electronics and aeronautics. The new directorate of administration will be headed by a three-star general.

Seven assistant directors in charge of specific program areas such as strategic weapons and tactical weapons will report directly to Rubel. He also will serve at least temporarily as director of programs. The other two directorates are for the Advanced Research Projects Agency and the Weapon Systems Evaluation Group.

Classified version of the Wiesner report suggests complete revamping or scrapping of Project Mercury, implying that the new Democratic Administration would get the blame if this first attempt at manned space flight fails. Best bet is that President Kennedy will reject the suggestion, taking the attitude that the U. S. government—not a political party—succeeds or fails when a national program is involved.

Sen. Robert Kerr wants highly qualified technical men to serve as director and assistant director of his Senate space committee, but he will not borrow technical advisers from the military services as the House space committee has done.

An expert borrowed from the Navy, for example, could "help convince the committee members that the Navy ought to have a larger responsibility in the area," Kerr said. Sen. Kerr's regular staff has been enlarged, and two more top staff positions have been created—possibly for an investigating subcommittee.

Army, Navy Space Bid

Army and Navy will make strong bids before the House space committee for shares in the military space program. They fear Air Force will try to freeze them out. Dr. York wants to testify after the services in order to explain why they have fewer space projects than they want.

Commerce Department plans a total of 120 surveys of the aircraft market in various countries and hopes to have them completed by June. One on Southeast Asia is now being prepared. Reports already published have covered Japan and Africa (see p. 40).

Observers interpret President Kennedy's remarks on the Gaither report to mean there is little chance of its release. Kennedy pointed out that it is three years old and based partly on assumptions that are no longer valid, and he indicated that security considerations might prevent release of other portions. The report, prepared by private citizens for the Eisenhower Administration, compared U. S. and Soviet strength and recommended substantial increases in the U. S. defense effort.

One top military procurement official believes defense costs would ultimately be reduced if the Renegotiation Act is allowed to expire next year. Contractors now have little incentive for tightening operations, he says, because resulting profits disappear in renegotiation. He believes the services have adequate methods for controlling contractor profits, but not efficiency of contractor operations.

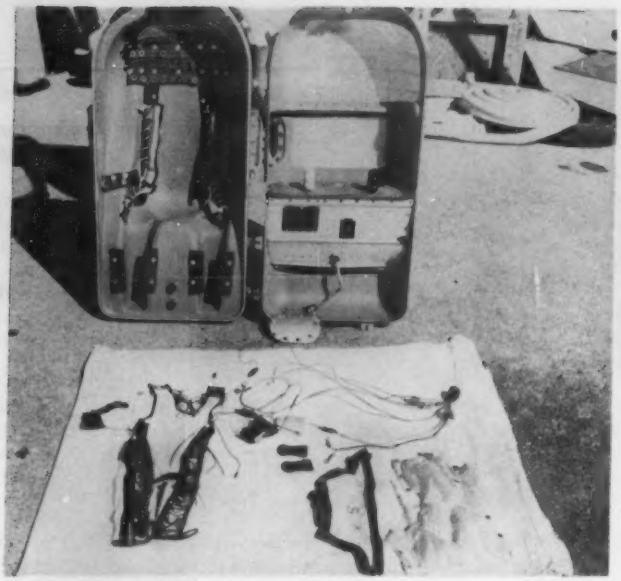
Nitze Defense Role

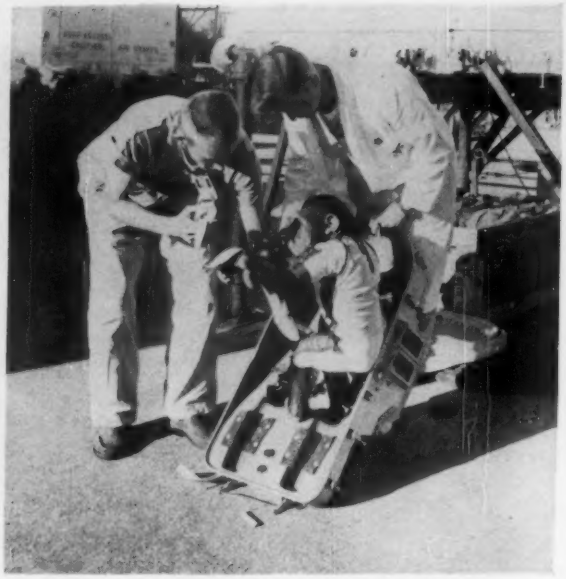
Watch for Paul Nitze, assistant secretary of defense for international affairs, to play a major role in strategic military planning. Pentagon colleagues consider him better informed than many specialists. Nitze's experience is chiefly in the areas of economic and international affairs rather than strategy, but he was director and vice chairman of the U. S. Strategic Bombing Survey in Europe.

Predecessors in the job have not helped to shape strategy to any great degree. Senators, questioning him when he was nominated, showed more interest in overseas procurement and in liaison with State Department, where Nitze once headed the policy planning staff, than in over-all approaches to defense.

Concept behind Air Force's proposed Positive Control Bombardment System, which would employ nuclear armed satellites, is running into opposition in the Pentagon. The satellites would be launched into orbit if early warning radars detected apparent intruders, and would be dumped into the sea later if the situation proved to be a false alarm.

Opponents of the concept say that the launching of hundreds of satellites in a few minutes could be caused by spurious radar echoes from meteorites or auroras and might appear on enemy radars as a massive U. S. ballistic missile attack. This might trigger, rather than deter, the launching of enemy missiles. —Washington Staff





CHIMPANZEE FLIGHT COUCH is detailed at left. Chimp in its couch was inserted into the Mercury capsule 155 min. before the scheduled 8 a.m. launch. At right, chimp is released from couch in ground test operation by handlers from the Aeromedical Field Laboratory.

Mercury Flight Provides Severe Test for

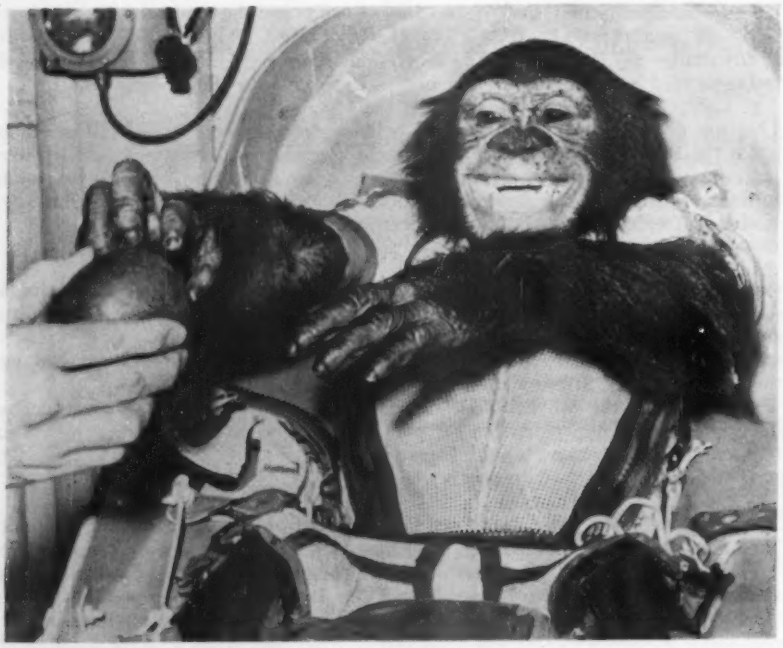
By Edward H. Kolcum

Cape Canaveral—Second Mercury-Redstone test, designed to flight-qualify the pilot environmental system, also provided an unexpected and severe test of the abort system last week when the booster lost power 5 sec. before programed burnout and triggered the escape sequence.

The MR-2 capsule contained a 37-lb. male chimpanzee whose sealed flight package was linked to a production life support system. Early data analyses indicated the system functioned normally, and the chimp had no difficulty performing a shock-avoidance psychomotor task (AW Jan. 30, p. 91).

Redstone thrust regulator, actually a throttle control, apparently jammed fully open at liftoff, causing high fuel consumption and producing added thrust and velocity. At 137 sec. after main stage ignition, fuel tanks were empty and pressure in the combustion chamber dropped. The abort system, linked to the combustion chamber, sensed thrust decay and automatically fired the escape rocket.

The combination of abnormally high velocity and operation of the escape motor is the apparent reason for the trajectory which was considerably higher and longer than the programed flight profile. The capsule landed 420 mi. down range after reaching a 155-mi. apogee. Program called for a 290-mi. range and 115-mi. maximum altitude. Attained velocity—5,000 mph.—was 1,000 mph. higher than anticipated.



CHIMPANZEE is shown after recovery from Mercury capsule. The 43-month old primate was selected from a colony of six who had been undergoing training.

Escape Rocket Fired

Redstone burnout is scheduled 142 sec. after liftoff, and at burnout the booster abort system no longer is linked with the capsule. When the sensor actuated the abort operation five seconds before burnout, the escape rocket ignited, carried the capsule several thousand feet from the spent booster, and jettisoned the rocket package. This would be the normal abort sequence, but it prevented firing of the retro-rockets and allowed the capsule to go on its full trajectory.

The beryllium heat shield either broke loose on impact or was separated from the capsule during retrieval operations. Two sailors from the destroyer USS Ellison were sent to the floating capsule in a rubber raft and righted it for a helicopter pickup. An HUS heli-

TOP cover is installed over flight couch containing the chimp. The Mercury capsule landed 420 mi. down range after reaching a flight apogee of 155 mi.

Capsule And Chimp

copter picked it up and put it on the deck of the landing ship-dock USS Donner 178 min. after launch.

The chimp passenger was given a preliminary post-flight physical on the ship, and was to be returned to Holloman AFB, N. M., for extended evaluation.

Mercury Director Robert R. Gilruth said the test was successful despite the high performance of the Redstone because it provided data on an animal passenger in a production capsule.

Although it is expected that the next Redstone mission will be a manned flight, possibly in March or April, Gilruth said data from MR-2 must be assessed before a decision is made on when to fly a pilot.

Test Flights Scheduled

Second Mercury-Atlas (MA-2) and the sixth Little Joe, both development flights containing instruments but no passengers, are scheduled for launch within the next 4-6 weeks.

The MA-2 combination will contain a stainless steel "belly band" around the adapter section where it joins the Atlas. This strengthener (AW Jan. 23, p. 23) already has been installed on the adapter as insurance against interstage connector structural failure.

The MR-2 capsule lifted off smoothly from its pad at 11:55 a.m. Jan. 31. Launch followed only one serious hold, caused by a loosened spring on a tail-plug flap. The spring was in an inaccessible area and required several hours to repair.

Inverters in the capsule began to overheat during the hold, resulting in a peak temperature of 180F between the two shells of the structure. Air hoses were used to purge the structure. The hot air did not get into the pressure section, which maintained a relatively level temperature of 65F.

Atlantic Missile Range telemetry recorded engineering and biomedical data during the first 12 min. of flight. Complete flight history was obtained from on-board telemetry recorders and two movie cameras. Quick look at the chimp biological data indicates a normal heart activity and respiration curve, even though the trajectory and velocity resulted in higher forces than planned. Analysis of peak loads was being made late last week, and the early estimate was a 7g launch acceleration, 12g re-entry acceleration and weightless flight time of about 5.5 min.

Astronaut Loads

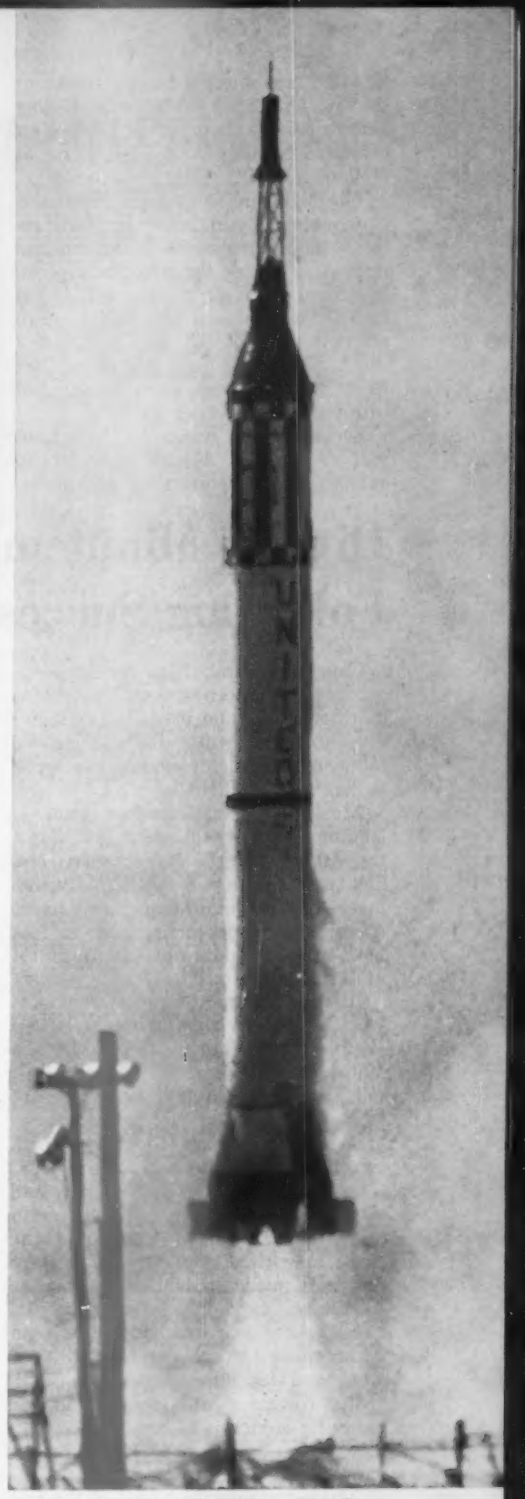
Nominal loads for the astronaut will be about 6g at launch; 11g at re-entry and 5.1 min. of weightlessness.

The MR-2 flight included a modification of the tactical field Redstone television camera (AW Aug. 8, p. 30) to record capsule separation.

Wide-angle camera, with *F* 1.5 lens opening, transmitted 30 pictures per second during 570 sec. of flight. The Lockheed-designed camera was installed in the booster instrument section and faced a set of mirrors aimed at the rocket exhaust during the powered phase. At the end of powered flight, the mirrors shifted to the payload. Ground monitors at AMR picked up the transmissions, which were recorded on 35 mm. film.

Camera field depth is 2 ft. to infinity, and it transmitted pictures with 600-line resolution. Camera weighs 3.8 lb., and housing and cables weigh 41.2 lb.

The 43-month old chimpanzee flown



MERCURY-REDSTONE-2 lifts off pad at Cape Canaveral, Fla., carrying a 37-lb. male chimpanzee—a prelude to possible March or April man-in-space flight.

in MR-2 was selected from a colony of six who have been undergoing training here to prepare them for the flight after extensive training by the Air Force at Holloman AFB.

The flight animal, named Ham, was chosen about 24 hr. before the flight on the basis of his physical condition and responses. During the selection process, he scored 25 lever movements during each 20-sec. interval and had a mean reaction time of 0.8 sec. to avoid a shock. During his flight, the chimp had to hit the lever once every 20 sec. and turn out a light every 5 sec.

Backup chimp was a 47.75-lb. four-year-old female. Flight and backup animals were instrumented identically, with rectal temperature probes and heart activity sensors. Base line data was taken during flight on the backup chimp for comparison.

The chimps have individual contoured couches, but because the animals vary in weight from 27 to 48 lb., small weights are added to the couch packages to arrive at a standard 94.5-lb. flight weight.

Sealed couch capsule was evacuated with 99% oxygen and 1% helium, the latter gas used to detect leaks. Chimp in its couch capsule was inserted into the Mercury capsule 155 min. before the scheduled 8 a.m. launch, and the performance task began 10 min. before launch.

Diverse Minuteman Tests Planned Following Successful First Flight

Cape Canaveral, Fla.—Air Force is preparing an ambitious test schedule for its three-stage, solid propellant Minuteman intercontinental ballistic missile following complete success last week in the first free-flight launch.

Minuteman was launched Feb. 1, landing about 4,000 naut. mi. down the Atlantic Missile Range on its first flight test. USAF will continue development flights from the pad and hopes to fire a Minuteman from a silo next summer and from a railroad car in late summer or fall.

Atlantic Missile Range test flights will be followed by launches from Pacific Missile Range. First PMR silo launch is set for mid-1962, and first rail car launch about three months later.

Test objectives of the first launch were first-stage ignition and liftoff. The Minuteman met its objectives and also provided data on performance of all three stages. Air Force said the flight was the first time an attempt has been made to launch a complete missile on the initial test.

The Air Force is relying heavily on Minuteman for economy in hardened sites, and for railroad mobility. Estimated cost of a Minuteman in its silo ready for launch is $2.4 million.

Components Tested

Major components tested in the first flight were:

• **Engines:** Thiokol's 24-ft. first stage, which develops approximately 170,000-lb. thrust in a 60-sec. burning time; Aerojet-General second stage, with 55,000-lb. thrust during a 60-sec. burning time; and Hercules 35,000-lb. thrust third stage, which has about 60-sec. maximum burning time varied by use of thrust termination vents to provide range control.

• **Guidance and control:** Autonetics all-inertial system which integrates control of all three stages during maintenance and flight modes in a single digital computer package. The computer is on a gyro-stabilized platform with three accelerometers on its frame.

The solid state computer translates data from the accelerometers and gyros into vector commands for the movable nozzles of the engine which is being powered. Each stage has four tungsten-lined nozzles, grouped in two pairs, with about 6-deg. freedom of movement. Lining is used to withstand the 6,000F exhaust heat.

Thiokol's first-stage engine, 5.5 ft. in diameter, has a thrust rating about 55,000-lb. greater than the Algol engine which is used as booster on the Scout and was the largest U. S. solid motor flown previously.

Thiokol Booster

Thiokol booster casing is made of six steel ring forgings, 0.12-in. thick and girth welded. Propellant is composed of polybutadiene acrylic acid and an oxidizer.

Hercules third stage engine fuel is a double-base mixture of aluminum and ammonium perchlorate in a nitrocellulose-nitroglycerin binder. It is cast internally and bonded to the glass fiber and resin casing. Thrust termination is performed in this stage by use of a vent for each of the four nozzles. When desired range is determined, a timer is set to blow out seals at the lower end of the engine, which vents combustion gases and causes thrust decay.

The 58-ft. Minuteman weighs about 66,000 lb., including a 1,000-lb. instrument section above the third stage. The instrument section, 1.5-ft. long, houses destruct and telemetry equipment and tracking beacons. Air Force says the Minuteman test vehicles differ from the operational vehicles only by inclusion of this instrument section.

Operational version of the Avco Mark 5 nose cone will be flown on all development launchings.

First flight originally was scheduled for Jan. 30, but it was canceled 27 sec. before launch when a no-go light was illuminated during check of the reentry vehicle. The light subsequently was found to be spurious. Ground checkout and automatic sequencer, located in the blockhouse, shut down, although the launch control timer ran to four seconds before launch.

The Feb. 1 launch was made at the extremely high liftoff velocity which characterizes solid boosters. Smoke trail was visible throughout first stage burning, another characteristic of solid propellants which is a cause for concern in that the missile trail will be visible comparatively close to the target. Ignition of all three stages in the first launch was confirmed optically by downrange stations.

First Stage Separates

First stage separation took place at about 20 mi., with a shaped charge wrapped around the middle of the interstage structure used for separation. Second and third stages carry the upper part of the interstage structure with them for stability and balance. The structure looks like a flared skirt and traps back-flowing exhaust. Nozzle vectoring activators are rubber-insulated to protect them from the hot exhaust.

Air Force said the first shot was used to establish operational launch sequence techniques, and its success meant that the system was unprecedented in a number of new areas. Among them:

• **An ICBM was assembled** at the launch site for the first time.

• **Digital computer** was used for inertial guidance and control.

• **Movable nozzles** were used on a large system.

• **Highest specific impulse** ever generated by solid fuels was produced.

Construction of the first hardened Minuteman complex in an area around Malmstrom AFB, Mont. is expected to begin next month after reconsideration of bidders' proposals. Bids were rejected in December when the lowest apparent bid of $79 million was $24 million over government's estimate.

Construction consists of building 150 silos, and the Air Force said the high proposals were caused by a requirement, which since has been scrapped, to start construction in the winter. USAF says delaying construction to March will not delay the Minuteman operational date.

Ten silos will be constructed as a unit, and by July, 1962, all 150 will be in some stage of construction. Completion is scheduled for July, 1963.

Kennedy Appoints Webb to Direct NASA

Washington—James E. Webb was named last week to head the National Aeronautics and Space Administration, ending a delay that had caused speculation that the Kennedy Administration considered the agency less important than had the previous administration.

Webb has no intimate knowledge of space technology but has shown a strong interest in scientific matters both as a government administrator and in private life.

Dr. Hugh L. Dryden was reappointed deputy administrator, a post he has held since NASA was created on Oct. 1, 1958. Former Administrator T. Keith Glennan submitted his resignation last Dec. 28—the first Eisenhower appointee to do so—and the fact that the Kennedy Administration filled his post only after a number of lesser positions had been filled hurt NASA morale (AW Jan. 23, p. 25).

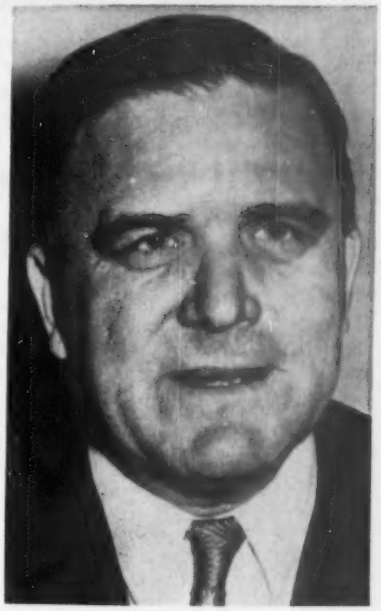
Webb, 54, is a former Budget Bureau director and under secretary of state. He has been a director and assistant to the president of Kerr-McGee Oil Industries, Inc., whose board chairman is Sen. Robert S. Kerr (D.-Okla.), chairman of the Senate Aeronautical and Space Sciences Committee. The company, in addition to its oil interests, is engaged in uranium ore processing. Dr. Jerome B. Wiesner, presidential science adviser, has been a consultant to Kerr-McGee.

Sen. Kerr said last week that Glennan will serve as a consultant to his committee, and said he is glad to have a man of Glennan's capabilities continue in government service.

Webb has been extremely active in private life since he last held a full-time government position. In addition to Kerr-McGee, he is presently associated with at least 21 other organizations in a variety of fields including science, education, public administration, management and urban studies.

Webb is a director of the McDonnell Aircraft Corp. and president of Educational Services, Inc., a non-profit organization aimed at improving science teaching in high schools which was founded by Dr. Jerrold M. Zacharias, newly appointed member of the President's Science Advisory Committee. He served as the first president of the Frontiers of Science Foundation of Oklahoma, Inc., from 1956 to 1957, and still is a trustee.

He also is a trustee of the newly formed Transportation Research Foundation of the Transportation Assn. of America. Webb said he has devoted about a third of his time to business and two thirds to public service in recent years. At a brief hearing on his nomination before Sen. Kerr's committee, he said he will cut all business and organizational ties not consistent with his new post and will sell all equities in companies active in the space field. Committee members praised Webb's record but asked him no questions about how he expected to handle the NASA job.



JAMES E. WEBB

Initiated Study

While he was Budget Bureau director from 1946 to 1949, Webb initiated a study of government research and development spending that was later instrumental in the founding of the National Science Foundation. At State, where he served from 1949 until 1952, he initiated a Massachusetts Institute of Technology study of U. S.-Soviet relations that resulted in creation of the Center for International Studies at MIT.

Prior to his service at the Budget Bureau, Webb was executive assistant to O. Max Gardner, former North Carolina governor who was then under secretary of the treasury. Webb, also a North Carolinian, was a member of Gardner's law firm when it handled the airline side of the air mail cancellations case.

Webb has the reputation of having a sharp analytical mind and an outstanding memory. Because of his past budget experience he is expected to take a direct hand in formulating NASA's budgets. His experience with scientific matters has led to speculation that the agency may for the first time get the necessary margin of general research and development funds over the amounts it needs for specific projects.

The new NASA administrator currently is a trustee and executive committee member of George Washington University; member of the Brookings Institution's advisory committee on presidential transition, the advisory council of MIT's School of Industrial Management, the visiting committee of the Harvard-MIT Joint Center for Urban Studies, the University of Oklahoma Research Institute, and the visiting committee of Harvard University's Graduate School of Public Administration.

From 1936 until 1943, Webb was with the Sperry Gyroscope Co., leaving there as a vice president.

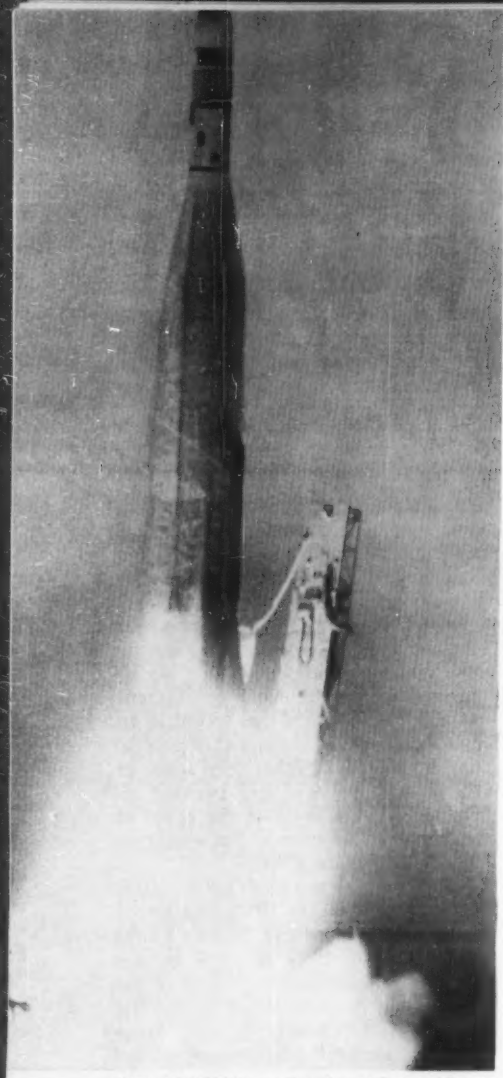
Since he left full-time government service in 1952, Webb has served in an advisory capacity to a number of government groups. He also has been active in Oklahoma City civic and banking affairs and was chairman of the board of directors of Simmonds Aerocessories, Inc., from 1953 to 1959.

Webb became a student naval aviator at Pensacola, Fla., in 1930, and served two years in the Fleet Marine Corps Reserve. From 1944 to 1945 he was a major and commanding officer of the 9th Marine Aircraft Wing of the 1st Marine Air Warning Group. Since 1950, he has been a lieutenant colonel in the Marine reserve.

Webb was born in Granville County, N. C., on Oct. 7, 1906. He holds an education degree from the University of North Carolina and a law degree from George Washington University.

Other Kennedy appointments:

- **Thomas K. Finletter,** former Air Force secretary in the Truman Administration, as U. S. Ambassador to the North Atlantic Treaty Organization.
- **Edward R. Murrow,** Columbia Broadcasting System official, as director of the U. S. Information Agency, and Donald M. Wilson, former Life magazine correspondent, as deputy director.
- **Carmine Bellino** who served as an accounting consultant to various congressional committees, as special consultant to the President and to the director of the budget. In this capacity, he will be available for special studies of administrative regulations and procedures as the White House and Budget Bureau request them.
- **Henry R. LaBouisse,** former State Department diplomat, as director of the International Cooperation Administration, and Herbert J. Waters, administrative aide to Sen. Hubert Humphrey (D.-Minn.), as deputy director.



ATLAS-AGENA used to boost Samos II into near-circular polar orbit is 77-ft. high.

Samos II Injected Into Polar Orbit

Pt. Arguello, Calif.—Samos II, boosted to altitude by an Atlas D, achieved a near-circular polar orbit very similar in character to orbits previously achieved by Lockheed Discoverer satellites.

Launched at 12:23 p.m. Jan. 31 from one of two Air Force launching pads located on the Naval Missile Test Facility here, the 4,100-lb. Agena second stage was injected into orbit by its 15,000-lb.-thrust Bell engine. About two hours after launch, the Air Force Satellite Test Center at Sunnyvale, Calif., announced that Samos II was orbiting the earth every 95 min. with an apogee of 350 mi. and a perigee of 300 mi.

Recovery of a capsule from Samos probably will be attempted at some future date since the satellite is designed to carry high-resolution cameras (AW Oct. 17, p. 28). The Air Force would make no official comment as to whether recovery attempts were scheduled on this shot nor will the fact that Samos carries cameras be confirmed. Judging from the near-circular orbit and its similarity to Discoverer orbits, recovery could be effected by the same method and with the same high degree of success as previous air snatches of Discoverer capsules by Fairchild C-119s.

The Atlas-Agena combination is about 77 ft. high and weighs 262,000 lb. at liftoff.

Thrust of the two Rocketdyne boosters is 150,000 lb. each with the sustainer developing 60,000 lb. for a total of 360,000 lb.

The Agena second stage weighs 11,000 lb. at separation and measures 26 ft. in length.

Vought Seeks Federal Injunction To Stop Ling Attempt at Control

Chance Vought request for an injunction restraining James J. Ling from further proxy incursions against the company has been set for Mar. 13 by the Dallas Federal District Court.

Chance Vought management has taken the issue to court claiming that companies headed by Ling "circulated intentionally false, deceitful and misleading rumors" in an attempt to gain control of the company.

The Chance Vought petition claims that Ling's efforts have raised the value of Ling-Temco stock (AW Jan 30, p. 28) approximately 50% in 60 days and that Ling is "conspiring to destroy Chance Vought as a competitor" by means which are not within the area of fair and honest competition and which, therefore, clearly subvert the purpose of the Sherman [Anti-Trust] Act."

Also alleged are efforts by Ling to form a monopoly in violation of Clayton Act provisions, plus violations of the Texas Intra-State Statutes.

Chance Vought had originally requested a Feb. 1 preliminary injunction to coincide with Ling's offer to purchase Vought common shares for $43.50 a share by that date. Since then Ling has extended his deadline to Feb. 8 although New York Stock Exchange listings for Vought shares soared to a comparable figure ($43.25, Feb. 1) last week. Inasmuch as Ling's offer of $43.50 eliminates commissions, Ling representatives feel they still have a potent appeal to Chance Vought stockholders.

In a report filed with the Securities and Exchange Commission, Ling admitted to having procured "in excess of 238,000 shares of Vought stock" which, according to Vought officials, "did not come as much of a surprise." These holdings, Ling representatives emphasize, "do not include certain tenders or stockholdings of the director."

The court-addressed petition asks that "This court . . . declare an order that the ownership of such stock is wrongful and unlawful and that the defendants are not entitled to, and shall not assert, claim or exercise, directly or indirectly, any of the incidents of stock ownership except to receive dividends, if any, that may be declared thereon, and except the right to dispose of such stock."

Named with James Ling as defendants in the petition, in an attempt to broaden the over-all impact against Ling, are Ling-Temco Electronics, Inc., Continental Electronics Manufacturing Co. of Dallas, Altec Lansing Corp. of Anaheim, Calif., United Electron Corp. of Richardson, Tex., Grady-Ling Electric, Inc., of Glendale, Calif., Temco Electronics and Missiles Co. of Garland, Tex., Fenske Electronics Co. of Newark, N. J., Fenske, Federick and Miller, Inc., of Los Angeles, Altec Companies, Inc., of Dallas, New Paths, Inc., of Dallas, Columbia Cabinet Corp. of Dallas, Ling-Altec Western Hemisphere, of Dallas, Lingco Realty Corp., of Dallas.

In an open newsletter, Chance Vought President Fred O. Detweiler stated that "It is the conviction of management that if Chance Vought stockholders will sit tight, the company will weather the present turbulent period. On their behalf vigorous efforts will be made to safeguard the present real values and future earnings potential of Chance Vought Corp."

In a later statement he said, "We will continue to oppose the attempts of Ling-Temco to take over Chance Vought—in the interest of our stockholders." Vought, according to the president, "is taking immediate steps to counter Ling-Temco's attempt to gain control of Vought."

A further element in the controversy is an investigation being conducted by the New York Stock Exchange over the gyrations in Ling-Temco Electronics stock apparently resulting from the Ling-Vought dispute. Commenting on the investigation, Ling-Temco said the investigation is "routine and being conducted solely because of excessive trading."

Ling has filed Form 14B with the Securities and Exchange Commission signifying its attempt to solicit proxies.

Kennedy Orders Defense Review, Boost in Airlift, Missile Programs

By Ford Eastman

Washington—Immediate action to boost military strength in three areas "most clearly needed now" and a complete reappraisal of U. S. military power were prescribed by President Kennedy in his State of the Union message to Congress last week.

At the same time, the President invited Soviet Russia and all other nations to join the U. S. in space technology experiments, including development of a weather prediction program, a new communications satellite program and exploration of Mars and Venus.

Kennedy Directives

While military strategy and capability is being reappraised, the President directed Defense Secretary Robert S. McNamara to take prompt action in these areas:

- **Increase airlift capacity** to obtain "additional air transport mobility."
- **Accelerate the Polaris** submarine program by using unobligated ship-building funds to place contracts now that were originally scheduled for the next fiscal year in order to put these submarines on station at least nine months ahead of schedule.
- **Accelerate the missile** program, largely through improved organization and decision-making and cutting down on "wasteful duplications and the time-lag that have handicapped our whole family of missiles."

To make the reappraisal of defense strategy requested by the President, Defense Secretary McNamara has named these four top civilian aids to direct study teams in four major areas:

- **Assistant Defense Secretary-Comptroller** Charles J. Hitch, to head a strategic weapon systems study.
- **Assistant Defense Secretary** for International Security Affairs Paul H. Nitze, to head a review of U. S. commitments abroad and force requirements for limited wars.
- **Research and Engineering** Director Herbert F. York to head a reappraisal of the field of weapons research and development.
- **Assistant Defense Secretary-Supply** and Logistics Thomas D. Morris to head a group which will consider the effectiveness and usefulness of U. S. domestic and overseas bases.

Later, McNamara said he is eliminating assistant defense secretaryships for bases, shifting that function to supply and logistics, and for health and medical affairs, shifting that to manpower. He also has created a management office under the general counsel to study reorganization.

The studies being made by these groups, which cut across service lines, will be correlated by McNamara, and preliminary conclusions are to be prepared for the President by the end of this month. The President said he would then recommend whatever legislative, budgetary or executive action is needed in the light of these conclusions.

The President observed that the U. S. is moving into a period of uncertain risks and great commitments in which both the military and diplomatic possibilities require a force powerful enough to make any aggression clearly futile.

"I have, therefore, instructed the Secretary of Defense to reappraise our entire defense strategy—our ability to fulfill our commitments—the effectiveness, vulnerability, and dispersal of our strategic bases, forces and warning systems—the efficiency and economy of our operation and organization—the elimination of obsolete bases and installations—the adequacy, modernization and mobility of our present conventional and nuclear forces and weapon systems in the light of present and future dangers."

Budget Review

At a press conference later in the week, Kennedy said he cannot say how much more money will be needed to reshape defenses until the Budget Bureau has reviewed programs recommended by the last administration and until he makes his own reappraisal. The military services already have prepared lists of additional needs at the Kennedy Administration's request.

McNamara also announced last week that an additional 53 military transports are to be bought, partially from Fiscal 1961 funds. They will include 30 Boeing C-135 turbojets—the first turbojet buy for airlift—and 23 Lockheed C-130 turboprop transports. First C-130s will be B models, to be replaced later by C-130Es. Delivery of the C-135s is to begin by July 1.

Airlift modernization advanced another step last week when Boeing, Convair, Douglas and Lockheed teams made oral presentations to USAF and Federal Aviation Agency on their proposals for the CX-1 jet transport to be built under Specific Operational Requirement 182 (AW Jan. 9, p. 37).

By transferring unobligated shipbuilding funds to the Polaris program, contracts for at least five Polaris submarines can be let now instead of waiting for Congress to appropriate Fiscal 1962 funds. This covers submarines No. 15 through 19 in a total Navy program of 45. It is also likely that funds will be requested by the Kennedy Administration for more submarines in the Fiscal 1962 program, since the five scheduled then will get under way now.

As for cooperation in the space effort, President Kennedy said the U. S. today is ahead in the science and technology of space, while the Soviet Union is ahead in the capacity to lift large vehicles into orbit.

"Both nations would help themselves as well as other nations," he said, "by removing these endeavors from the bitter and wasteful competition of the cold war. The United States would be willing to join with the Soviet Union and the scientists of all nations in a greater effort to make the fruits of this new knowledge available to all."

The U. S. has offered a number of times in the past to cooperate with Russia, but President Kennedy's suggestion of specific programs and Russia's current inclination to appear cooperative might combine to produce greater results than earlier offers have.

Nuclear Engine Progress

Washington—Testing of Heat Transfer Reactor Experiment No. 3 (HTRE-3), which included the first start and operation of two General Electric turbojet engines on nuclear power alone (AW Dec. 26, p. 15), has been completed successfully and preparations are being made for tests of more advanced aircraft reactors, Atomic Energy Commission said last week.

HTRE-3 was used to test higher performance reactors than those used earlier in GE's direct-cycle system tests. AEC also said it plans to begin construction of a facility at its Idaho station early this year to test the indirect-cycle aircraft reactor being developed by Pratt & Whitney under the joint AEC-USAF Nuclear Propulsion Program.

Centaur Explosion

Washington—Explosion of a Centaur liquid hydrogen rocket engine at Pratt & Whitney's Florida Research and Development Center has put a vertical test stand out of commission for the second time in recent months.

First Centaur explosion occurred last fall, and the cause was traced to human error. First test of a complete engine package since the stand was repaired took place last month. One 15,000-lb.-thrust engine lighted properly, but the second failed to light on time and pumped out a quantity of liquid oxygen and liquid hydrogen, causing the explosion.

AEC Skeptical About Prospects For Nuclear Test Ban Agreement

By Katherine Johnsen

Washington—Atomic Energy Commission presents a highly skeptical outlook on the prospects for success of a nuclear test ban agreement—the first challenge confronting the Kennedy Administration's arms control program—in its 1960 annual report, submitted last week to Congress.

The commission believes that detection and proof of either an underground or outer-atmosphere atomic detonation—prerequisites for an adequate policing system, which, in turn, is the key to any test ban agreement—is virtually impossible at this time.

The report said the U. S., Great Britain and Russia, after negotiating for over two years, "still had not reached agreement on the major issues."

The commission also warned that while the U. S. has voluntarily suspended nuclear testing since October, 1958, Russia could be achieving "dramatic advances" in nuclear weapons technology through hidden tests.

"Important advances in weapons design are possible—advances which would have great military significance," the report commented. "They could include improvements in many fields, such as new 'battlefield' weapons and improvement of the weight-to-yield ratio of a variety of bombs and warheads. Our weapons scientists are convinced that further nuclear testing would achieve major advances in weapons design."

Developing New Weapons

Over the past year, AEC said, the results of laboratory study and analysis of data obtained in tests preceding the 1958 suspension have been translated into operational weapons to meet specific military requirements. "These efforts have been fruitful and defense needs for numerous weapons of various weights and yields have been met," AEC noted. The commission also disclosed that a "retirement program" of obsolescent weapons was under way during the year. Nuclear materials were salvaged and other materials in the discarded weapons destroyed or scrapped.

The report was signed by Chairman John A. McCone, who has resigned and will be succeeded by Dr. Glenn T. Seaborg, a nuclear chemist and chancellor of the University of California. The report also was signed by Commissioners John S. Graham, Loren K. Olson, and Robert E. Wilson. There is one vacancy on the commission to be filled by President Kennedy.

Three-power test ban negotiations, scheduled to be resumed Feb. 7, have been postponed at the request of the U. S., and they will probably take place in March. This course was recommended to President Kennedy by a task force that included Dr. Jerome B. Wiesner, chairman of the White House Science Advisory Committee, and Paul H. Nitze, assistant secretary of defense for international security affairs, to allow time for sound preparation.

A 12-member panel under the chairmanship of Dr. J. B. Fisk, president of Bell Telephone Laboratories, is studying the technical considerations bearing on an agreement. It includes four AEC representatives, two representatives of the secretary of defense, three university representatives, and one each from the White House, Air Force and Rand Corp.

Declaring arms control "a central goal of our national policy under my personal direction," President Kennedy observed in last week's State of the Union message to the Congress:

"I have asked the other governments concerned to agree to a reasonable delay in the talks on a nuclear test ban—and it is our intention to resume negotiations prepared to reach a final agreement with any nation that is equally willing to agree to an effective and enforceable treaty."

On detonations "above the sensible atmosphere" which produce little, if any, fall-out, AEC said: "Adequate detection methods for such tests do not now exist and, in fact, cannot be proven to be effective without further extensive research and experimentation in this medium."

On detection of underground explosions, AEC emphasized these points:

- **Current instrumentation**, even if installed world-wide, could provide information only on the location of "significant" seismic events.
- **Only "in some cases"** could it identify the event as an earthquake or other natural disturbance.
- **The instrumentation** cannot distinguish between nuclear and conventional explosions—such as might be used in mining or construction work.
- **There is the possibility** of nuclear detonations being hidden by the "decoupling technique." This technique involves use of a large underground cavity so that seismic signals from a detonation would be reduced by a factor as great as 300.

AEC noted that more than 100 "locatable" seismic events of greater than 4.75 magnitude occur annually in the Soviet Union, plus "thousands" of seismic events lower than 4.75.

"There is no known way of proving that an underground nuclear explosion has occurred other than by on-site inspection which, in order to achieve the difficult objective of proving a violation, involves extensive drilling operations to obtain a sample of radioactive debris," AEC pointed out. So far, Russian negotiators have offered to permit only three "on-site" inspections a year in their country for all unidentified seismic events.

Vela Program

The commission outlined the Vela program aimed at improving the U. S. nuclear detection capability. Ten million dollars was funded for the program in Fiscal 1960 and $66 million for the current fiscal year. Participating in the program, in addition to AEC, are Defense Department, Commerce Department, Interior Department, universities and private organizations. The three parts of the program are:

- **Vela-Uniform** includes underground nuclear and high explosive detonations to provide signals for the development of new seismic instruments. AEC has called for bids for exploratory drilling in a Mississippi salt dome to determine if it is suitable as a site for the nuclear detonations. The commission is also preparing sites at its Nevada Test Site for the detonations. Plans call for 11-12 high explosive and 11-13 nuclear detonations, but a schedule has not yet been established in view of the test suspension.
- **Vela-Sierra** is to develop ground-based instruments for detecting nuclear explosions in near space. AEC's Los Alamos Scientific Laboratory is now testing an experimental air fluorescence detection station, and it is developing an experimental direct optical detection station to examine reactions to natural phenomena in near space.
- **Vela-Hotel** is to develop satellite-based instruments and systems for nuclear detection in space. The Los Alamos Laboratory and Sandia Corp., a subsidiary of Western Electric Co., are carrying out research and development on instrumentation for satellites, and AEC's Lawrence Radiation Laboratory is engaged in space background measurements.

AEC did not view detection of atmospheric and underwater detonations as significant hurdles to a ban agreement. Sampling stations and sampling flights could detect nuclear detonations "of any appreciable size" from fall-out in the atmosphere, AEC said. Similarly, AEC said, hydro-acoustic stations could monitor underwater detonations. Evidence of radioactivity would be rapidly dispersed in vast quantities of water.

GAO Criticizes Unnecessary Flight Pay

Washington—Air Force has been accused in a General Accounting Office report of spending $183 million during the current fiscal year to provide proficiency flying for 27,000 pilot officers who are either not needed or are in non-flying jobs.

Since GAO is an agency of Congress, the critical report provides an indication of the attitudes which may be encountered by proposed legislation which is designed to alleviate the financial impact on pilots removed from flight status (AW Jan. 23, p. 25).

GAO said that of 71,844 rated pilots, navigators and observers on flying status June 30, 1960, nearly 40,000 were not required for crew positions. About 1,500 aircraft are assigned specifically for proficiency flying, the report noted, and aircraft assigned primarily to other duties also are used. Over 40% of the total hours flown for proficiency in Fiscal 1960 were flown in C-47 cargo-type aircraft.

The report, prepared for Rep. F. Edward Hebert (D.-La.), chairman of the Armed Services Investigations Subcommittee, expressed little sympathy for USAF pilots. Comparing pilots with non-pilots, it stated: "Rated personnel who are advanced in age and grade, and well advanced in non-flying careers, are by necessity assigned to support activities. This often results in rated officers and non-rated officers performing identical assignments, but with the rated officer receiving a higher rate of pay."

USAF Reply

Replying to GAO, Lyle S. Garlock, then acting secretary of the Air Force, indicated that when an attempt was made to ground pilots on a quantitative basis late in 1959, affecting more than 2,000 pilots, "the impact of the implications of this action upon the entire officer structure of the Air Force was such that before these groundings were effected the action was revoked. . . ."

Pilots express strong objections to any moves designed to cut flight pay. They argue that they signed for careers as pilots and that any action to take away their flight status is a breach of contract.

Many say they will quit rather than take a cut in pay.

Army and Navy escaped GAO criticism. Both services have inventories of rated officers slightly below official requirements. Navy was found to have taken action to remedy defects found in the report which apply to the Air Force (AW Dec. 12, p. 129).

The report was critical of past failures to reduce proficiency flying. One example cited was lack of action in taking advantage of provisions in appropriations acts since 1954 which stated that officers with more than 20 years of flying status may be excused from further flying, and still receive their flight pay. Navy implemented the provisions uniformly 18 months ago, while the Air Force implemented them partially for generals and colonels last December.

GAO claimed that more than 10,000 pilots are in excess of Air Force needs and that a saving of $42 million could be effected in aircraft maintenance and operating costs by eliminating them. Another 17,000 pilots fill positions designated as requiring proficiency flying. GAO observed that the positions do not appear to require flying skills and that another $70 million could be saved here. Requiring these officers to fly takes time from their regular duties, the report said.

Last October, the Air Force central board reviewed 3,758 officers for fitness to remain on flying status. It recommended that 728–622 pilots, 101 navigators, five flight surgeons—be dropped. A current series of boards already has reviewed 12,000 records and will review 24,000 more. Results and recommendations will be announced later.

To soften the impact on pilots recommended for loss of flight status, the Air Force last year proposed a system of accrual pay in which a pilot would be guaranteed a portion of his flight pay after being removed from flight status. This retained flight pay would be in proportion to length of service.

Since this plan was received with little enthusiasm in Congress, a substitute called requital pay was proposed. It would call for an officer removed from flight status to receive gradually reduced pay, at the rate of 5% per year, until the monthly rate was $100, when it would be eliminated completely. A decision proposing this plan to Congress awaits White House action, and the rate of reduction probably will be increased to 10% before it is submitted.

Two examples of the high cost of proficiency pay were cited by GAO. Providing aircraft for officers at the Air University in Montgomery, Ala., who fly at Maxwell AFB, costs $2 million a year, and it takes 255 men to support the flying. Another example cited was the cost of moving proficiency flying activities from Bolling AFB, Washington, D. C., to nearby Andrews AFB, Md., as operations are being reduced at Bolling.

Emphasis in the report is on the increasing age of pilots and their potential for combat flying. The report showed that in Fiscal 1954, there were 281 officers who were rated more than 20 years, and there were 1,528 in 1960. It is estimated that this category will increase to 9,484 in 1963 and to 19,116 in 1965.

Actions Taken

In his reply, Garlock pointed out these recent actions taken by the Air Force:

- **Three-fold reduction** of the annual training rate.
- **Suspension from flying status** for all causes of more than 4,250 officers.
- **Application of provisions** in the appropriations act to waive flying requirements of 50% of all officers rated 20 years or more.
- **Elimination of proficiency flying** requirements for officers whose retirement or separation dates have been determined. Pilots have been placed on a familiarization status of flying four hours per month for pay purposes.
- **Refinement and development** of the system of identifying positions requiring rated officers.
- **Board action** currently in progress to determine those not selected for positions requiring pilots. These will be placed on familiarization status pending passage of recommended legislation.
- **Action initiated** to obtain certain amendments to Executive Order 10152, which refers to flight requirements for pay purposes, to solve flight pay qualification problems for officers on temporary duty at schools and related assignments.

USAF Consolidating Basic Research Work

Washington—Basic research contract portion of the USAF Aeronautical Research Laboratory's work will be transferred to the Air Force Office of Scientific Research here by late spring or summer.

Most of the laboratory's research is done in-house, but it is augmented by contracting. Almost all of OSR's research is done on contract. As part of a continuing realignment of basic research activities, Air Research and Development Command will separate 10 scientists and the contracts they administer from the laboratory, leaving them temporarily in a unit under the laboratory's control at Wright-Patterson AFB, Ohio, and transferring them to OSR later. Both the laboratory and OSR are under ARDC's Research Division.

Continuous-Output Optical Maser Demonstrated by Bell Laboratories

A new type of optical maser, which uses gaseous discharge of neon and helium gases to produce a continuous output of coherent infrared radiation instead of the intermittent pulse type operation obtainable with previous devices that used solid-state crystals, was demonstrated last week by Bell Telephone Laboratories.

The continuous radiation output available from the new type of optical maser opens the way to its use in communication systems, as a possible substitute for radio in earth-to-satellite and satellite-to-satellite communications and as a replacement for landlines and coaxial cable in terrestrial communications.

Another novel feature of the gaseous discharge maser is the fact that its radiation has a spectral line width which is 100,000 times narrower than that obtainable from previous solid-state optical masers, BTL reports. This property has permitted the observation for the first time of difference-signals at radio frequencies between two optical lines. Using a Kerr Cell, BTL scientists have successfully voice-modulated the output beam from an experimental gaseous discharge maser to conduct a telephone conversation. Broadband modulation up to a frequency of 60 kc. has been accomplished to date, and BTL says that other modulation methods should permit bandwidths of several thousand megacycles.

Unlike the earlier solid-state optical masers, using ruby crystals, which had to be excited (pumped) by a high-intensity external light source (AW Oct. 24, p. 75), the new BTL device generates its own pumping action by electrical discharge. Excitation energy required is relatively low, measured in tens of watts, to provide an optical output power of about 0.01 watt from the present experimental models. Higher output power levels can be obtained by using large diameter tubes.

Another novel feature of the gaseous discharge maser is its ability to produce radiation at a variety of different frequencies, depending upon the mode in which the device is operated. Present experimental units have radiated at five different wavelengths between 11,000 and 12,000 angstroms, but up to 30 discrete wavelengths between 9,000 and 17,000 angstroms are possible using neon and helium gases, BTL says.

The BTL gaseous discharge maser consists of a neon- and helium-filled glass tube, approximately 40-in. long, with semi-reflecting plates at each end. The tube has a center electrode and two more at either end, the latter electrically connected.

When a radio-frequency voltage is applied across the center and end electrodes, a gaseous discharge is produced in much the same manner as in a conventional neon tube. This excites the helium atoms, causing them to jump to a very high upper metastable energy level from which they normally do not radiate energy.

When these excited helium atoms collide with neon gas atoms, energy is transferred to the neon atoms which causes them to jump to one of four upper metastable energy levels.

As the neon atoms fall back to one of 10 possible different intermediate energy levels, they give off infrared radiation which is reflected back and forth through the length of the gas-filled tube by the semi-reflecting end plates, growing in intensity with each transit. A portion of the energy passes through the silvered end-plates, forming a very narrow beam of coherent radiation which represents the maser's output. This beam has a width of only one minute of arc.

A few of the neon atoms fall below the intermediate energy level to the lowest (ground) state, giving off a non-coherent reddish yellow light similar to that seen in conventional neon tubes.

There are four possible upper energy levels to which the neon atoms can be pumped, depending upon operating mode, and 10 possible intermediate levels to which they can fall in emitting coherent infrared radiation, although not each combination of upper and intermediate energy levels can produce such radiation. There are 30 different combinations which are useful for optical maser action when neon and helium are used, each providing a different radiated wavelength from the device. By using combinations of other gases, BTL says it should be possible to produce different output frequencies.

BTL says that the new gas optical maser and the solid-state versions are expected to complement each other in their applications. The solid-state maser, essentially a high-power device, may find important uses where its pulsed output is not objectionable.

Theoretical Study Group

Washington — Theoretical research group that will make use of space talent at universities and research centers in the New York City area will be established in May by the National Aeronautics and Space Administration.

Dr. Robert Jastrow, chief of the theoretical division of NASA's Goddard Space Flight Center here, will direct the institute. It will be called the Goddard Institute for Space Studies, will have a staff of approximately 50, and will use scientists in the New York area as part-time consultants. Prof. Maurice Ewing of Columbia University and Prof. Bengt Stromgren of Princeton University's Institute for Advanced Study already have accepted consultant appointments.

Areas of study will include structures of the earth, moon and other planetary bodies in the solar system; planetary atmospheres; origin and evolution of the solar system; properties of the interplanetary plasma; sun-earth relationships; celestial mechanics, and structure and evolution of the stars. No office site has been selected for the institute.

Anti-ICBM Competition

Los Angeles—At least five proposals will be submitted to Aerospace Corp. by Feb. 13 for continued studies of concepts for destroying enemy intercontinental ballistic missiles while they are still in their boost phase.

Studies, known as Bambi (Ballistic Missile Boost Intercept), involving several competitive approaches to satellite-borne defense systems (AW Oct. 31, p. 33; Dec. 5, p. 26), will be funded by Advanced Research Projects Agency with Aerospace Corp. having technical and management responsibility (AW Jan. 16, p. 26).

Among the bidders will be Boeing, Convair, Space Technology Laboratories, North American Aviation and Hughes Aircraft. North American will head a team consisting of International Business Machines Corp., Raytheon and Electro-Optical Systems. A Hughes team will consist of McDonnell Aircraft, Avco and United Technology Corp.

Proposals will be evaluated in early March and one or more contracts for continued studies of the complex problem of defense against ICBMs will be awarded shortly thereafter.

Earlier studies of satellite-borne anti-ICBM systems, all part of the Bambi program, have been supported by ARPA at Convair (satellite protection for area defense system), Thompson Ramo Wooldridge and later its Space Technology Laboratories (random barrage system) and Lockheed (Insatrac system). Lockheed, however, will not submit a bid in the current competition.

Funding level for these studies will again be in the several million dollar category. Ultimate cost of one of the satellite systems, should it move beyond the study phase, will run beyond $5 billion, according to the most conservative estimates.

European Space Plan Set at $200 Million

Strasbourg—An European space program will cost about $200 million in a five-to-six year period, representatives of 10 nations were told here last week at an initial governmental space conference (AW Jan. 23, p. 34).

Sponsors of the conference, Great Britain and France, proposed a program to develop space launch vehicles using a de Havilland Blue Streak intermediate range ballistic missile as first stage, an improved French Veronique sounding rocket as second stage and an European-developed first stage. Costs would be borne by member nations in proportion to their national income.

French plan is to gradually improve the Veronique from its present 8,800-lb. thrust to an eventual 55,000-lb. thrust over a two year period. About 20 Veronique launches are planned for this year, according to Francois de Rose, head of the French delegation.

Peter Thorneycroft, British Minister of Aviation, emphasized that none of the $168-million British investment in Blue Streak development would be recaptured in the proposed European program. Nations also would have use of the near-completed launch site at Woomera Range in Australia.

In addition to Great Britain and France, the conference was attended by representatives of Belgium, The Netherlands, Norway, Spain, Sweden, Switzerland, Austria, Denmark, West Germany and Italy. Canada, Greece and Turkey sent observers. No formal action was taken on the Franco-British proposal, pending study by the governments involved.

Ryan, North American Win Saturn Studies

Washington—Work on a recovery system for the Saturn rocket booster that would have required a sea landing has been curtailed in favor of studies that may lead to land recovery of both Saturn and its S-II upper stage by means of a Rogallo-type flexible glider wing.

Contracts for six-month studies were awarded last week to Ryan Aeronautical Co. and North American Aviation, Inc., by National Aeronautics and Space Administration's Marshall Space Flight Center. Both had previously made unpaid studies on Rogallo wing recovery systems. North American's contract is for $170,000 and Ryan's is for $145,827.91.

First test of the Saturn booster, carrying two dummy upper stages, is planned for later this year, but no recovery will be attempted on early flights. Marshall is considering other possible recovery systems, but the original scheme for a water landing for Saturn apparently is being abandoned.

Sea recovery would have required an attitude control system, an inflatable drag cone, a parachute system and eight retrorockets, sea pickup and reconditioning of the booster after its exposure to salt water. Cook Electric Co. has been developing such a system under NASA contract, but NASA said this work now is being "curtailed."

The Saturn booster is 82-ft. long, 21.5 ft. in diameter and will weigh 100,000 lb. after burnout. The "paraglider"—or combination parachute and glider—probably would be folded longitudinally between two outer tanks of the booster. Unfolded, the wing might be more than twice as long as the booster.

The companies will study several types of wings, plus inflight, approach and landing control systems. Final landing, which would be made at some site not yet selected, would be ground controlled.

The Rogallo wing basically is a lightweight, triangular, collapsible structure that has been proposed as a "kite" to aid in re-entry and recovery of a variety of space vehicles. It was developed by a group headed by Francis M. Rogallo at NASA's Langley Research Center (AW Sept. 19, p. 57).

News Digest

U.S. scheduled airlines have set a timetable for installation of distance measuring equipment which calls for turbojet aircraft to be equipped by Jan. 1, 1963, turboprop transports by July 1, 1963 and pressurized piston-engine aircraft by Jan. 1, 1964. At the end of 1960, 81 turbojet transports had been equipped with DME.

Trans-Texas Airways has purchased 22 Convair 240 transports from American Airlines (AW Oct. 17, p. 40). Delivery will begin Feb. 15 and Convair service will begin Apr. 1 on the Houston-Port Arthur route. Cost of the aircraft, including spares, radar and ramp equipment, was $4.5 million. Trans-Texas currently plans to keep its DC-3 fleet in service.

Hunting Aircraft, Ltd., is building a single-seat turbojet-powered research plane to explore principles of boundary layer control over flap surfaces. Plane is designated ER 189.D and will be powered by a Bristol Orpheus engine, probably a basic model modified to supply high-pressure air to the surfaces.

Rover Nuclear rocket bids have been requested by the joint National Aeronautics and Space Administration-Atomic Energy Commission Nuclear Propulsion Office, and they are due Apr. 3. Contract will be for first phase, including assistance in the Kiwi-B test program and test work on non-nuclear components, but the contractor chosen must be capable of carrying out the full engine development program.

North American Aviation, Inc., reported a net income of $4,601,000 for the first quarter ending Dec. 31, 1960. Sales and profits for the first quarter of 1961 were less than the 1960 comparable period.

Aerojet-General has successfully static-fired a 20-ton Bimbo experimental segmented solid fuel rocket which produced 400,000 lb. thrust in a horizontal hold-down condition. The cylindrical engine uses standard polyurethane fuel (AW Dec. 12, p. 26). Bimbo is part of an Air Research and Development Command program to develop a transportable segmented rocket which can be assembled at launch site.

Royal Air Force Mark II Vulcan was at Douglas Aircraft Co.'s El Segundo facility last week for checking electrical compatibility of the aircraft with the Skybolt air-launched ballistic missile, and then left for Wright-Patterson AFB for further compatibility checking.

Bell Aerosystems Co. will study feasibility of construction of a visual space-flight simulator under contract to USAF. Basic design uses a theater containing full-scale space-vehicle cabin plus separate studios where closed-circuit TV presentations will be originated for projection on cabin windows.

USAF Gen. Lauris Norstad will remain as supreme commander of NATO indefinitely, the White House announced after Norstad conferred with President Kennedy last week.

Discoverer Monkey

Cape Canaveral, Fla.—Air Force is scheduled to launch its first primate into orbit in mid-March with a Discoverer flight from Pacific Missile Range carrying a Rhesus monkey.

National Aeronautics and Space Administration's successes last week in firing a chimpanzee down the Atlantic Missile Range in the MR-2 capsule (see p. 26) apparently cleared the way for the Air Force to make its first orbital primate flight. NASA reportedly persuaded the Eisenhower Administration to cancel a USAF monkey flight scheduled last October until the space agency had made a successful primate flight in the Mercury program.

United Crowds American's Revenue Lead

Jet passenger mile power play finds United making most of American's commitment to turbofan retrofit.

By Glenn Garrison

New York—United Air Lines has overcome its late start in the domestic jet competition and is fast overtaking American Airlines in production of revenue passenger miles.

Both American and Trans World Airlines led United in passenger miles during much of 1959, when United was the only one of the three without jet transports. But United's jet fleet is now the largest of the three, and, having long since passed TWA, United last December almost caught up with American in total passenger miles for the month.

For American, a major part of 1961 will involve a strong disadvantage because of the carrier's commitment to turbofan power for all its jets. American has started pulling planes off the line for conversion, and its jet fleet will be at its lowest ebb during the first three months of this year.

Jet Fleet Lead

During the first quarter of 1961, United may have as much as a 20-jet lead over American. Trans World also will be a few jets ahead of American.

Depending on a number of factors such as delivery dates being met, the situation by the end of this year will see United's lead cut to about 14 jets and TWA behind American by about 10 planes.

The imminent merger of United and Capital (see p. 38) will change United's fleet structure and is not considered in this comparison with American.

American's commitment to turbofans was made with the knowledge that a temporary fleet disadvantage was involved. But the airline's position is that future performance justified this setback. American believes the program will pay off in terms of operating economy and competitive speed advantage. According to American, its fan-powered Boeing 707-120Bs and 720Bs can be advertised as the fastest transports in the air. Deliveries are expected to begin next month.

Turbofan DC-8s

United does not share American's preference for turbofans. The carrier has ordered three turbofan Douglas DC-8s which are expected to go on the long-range route between Chicago and Hawaii. United's other DC-8s, 15 of which are powered by Pratt & Whitney JT-4A-3 engine, are considered adequate to handle domestic runs.

American's jet capacity situation worsened by the recent loss of 707-120 in the crash of a training flight. It was the second such loss for American. United, on the other hand, lost the capacity of a DC-8 in last December's collision over New York.

The criss-cross of numerical jet fleet superiority from American to United began last year. American's revenue passenger miles for 1960 totaled about 6.288 billion vs. United's 5.388 billion. But over the months, American's lead lessened. In January, 1960, American ran up a total of 508 million seat miles vs. United's 352 million. Last December, American's total was 464 million and United's a shade behind at 442 million.

United's total of passengers carried exceeded American's during the last part of the year, although American's total for the year was higher (7,522,136 passengers during the first 11 months vs. 6,977,056 for the same period).

The transcontinental jet race began in January, 1959, when American's first 707-120s went into service. TWA followed in March. By August, not only American but TWA led United in revenue passenger miles. United not only was without jets but was pulling back piston schedules in the face of the jet competition.

Jet Chronology

United received its first 15 DC-8s in late 1959 and the first went into service that September. In February, 1960, United's passenger mile total passed TWA's again and by last summer United was closing the gap on American.

American's fleet has now entered its numerical low point. There are 19 Boeing 707-120s and 10 of the 720s in service, a total of 29 jets. Two 707-120s are in Seattle for the turbofan conversion, a process which is expected to average about one month per airplane. The 720s also will be fed into the conversion program and as many as six airplanes at a time may be in the line at various stages of conversion.

American will be receiving another 15 of the smaller Boeings, which are 720Bs already turbofan equipped. Delivery of these, as well as of the first converted 120Bs, is expected to begin next month.

By the middle of 1961, American expects to get the first of 25 Convair 990s, also turbofan powered, and to receive about half of the total order by the end of this year. All the fan-pow-

707-120 Salvage Attempts

New York—Investigators were attempting to salvage the wreckage last week of an American Airlines 707-120 which crashed Jan. 28 into the Atlantic Ocean just off the Long Island shore. Six persons were killed in the training accident.

Salvage efforts had not proved very successful by last midweek. The aircraft's flight recorder had not been found. Civil Aeronautics Board investigators said preliminary indications were that No. 1 engine had separated from the jet before it crashed, possibly during an attempted recovery. The probable maneuvers being flown at the time had not been pinpointed.

It was the second 707 lost by American in training accidents in the Long Island area, where training flights normally are conducted. The first occurred Aug. 15, 1959, during an attempt to land at Calverton, Long Island, while the plane possibly was in an asymmetrical two-engine-out condition. A result of this crash was a re-study of training procedures and the elimination of two-engine-out maneuvers at low altitude.

Alitalia Expands Jet Fleet

New York—Alitalia has picked up options on two additional Douglas DC-8 jets and four Sud Aviation Caravelles. The DC-8 fleet in service or on order now totals 10.

Also, the Italian carrier has ordered an additional two Caravelles, raising the fleet total of the French twin-jets to 14.

ered Boeings, if delivered according to schedule, will be in service by the end of 1961. At that time, therefore, the carrier's jet fleet will be entirely powered by fan engines. American will sell the fan angle vigorously, calling its airplanes "Astrojets." The fleet total at year-end will be 62 airplanes. This includes a 26th 707-120 the airline bought to replace its first training crash loss and which has been flying as a test airplane for the fan conversion.

United now has 32 of 40 DC-8s ordered and expects to have the rest by the end of this year. Subtracting the lost airplane, the DC-8 total will be 39. The three fan-powered planes in this total are scheduled for delivery this spring. United has 16 Boeing 720s now in service, expects the total to reach 18 by April with an additional order of 11 to be delivered next year. First of 20 Sud Aviation Caravelles are expected to go into service in mid-summer, with 19 of the total in service by year's end. At that point, then, United's jet fleet is expected to total 76 airplanes.

TWA's present jet fleet includes 27 Boeings and seven Convair 880s. The domestic total, however, is 26 jets, because the Boeings divide into 15 707-120s and 12 707-320s. Four of the big Boeings and all the 120s are in domestic service and the other aircraft are on overseas runs.

The 880 order, long delayed by financing troubles, totals 20 airplanes and all are expected to be delivered this year. The year's end TWA total domestically, therefore, should be 39 jets.

In comparing American's and United's fleet situations, an interesting question is American's future move regarding short-range jets. United has ordered 20 firm and 20 conditional Boeing 727 tri-jet transports (the conditional 20 now looking firm with the imminence of the merger), which are scheduled for delivery beginning in 1963. And United will be flying at least 20 of the twin-jet Caravelles.

American, on the other hand, has not announced plans to buy a short-range jet. Its Lockheed Electra turboprops were scheduled to meet short-range requirements for some time. United skipped the turboprop phase entirely.

The above fleet statistics indicate a jet equipment situation at the end of this year in which United leads with 76 various jet transports against 62 jets for American and 39 domestic jets for TWA.

American's 1960 revenue passenger mile total of 6.288 billion compares with 5.619 billion for the airline in 1959, while United's 1960 total of 5.388 billion compares with 4.878 billion in 1959.

American's December, 1960, total of 464 million passenger miles was a 6% decrease from the previous December total. United's total for December, 1960, of 442 million represents a 30% increase over that month of 1959. Of the American total for December, 1960, some 237 million was in coach service, a 22% increase; the 227 million first class total represents a 25% decrease. Of United's total, 255 million miles were coach, a 62% increase, and 187 million were first class, a 3% increase.

With the variety of new jets entering service, the transcontinental nomenclature battle may be expected to rage furiously. As noted, American will be flying "Astrojets." TWA's big Boeings are now billed as "Superjets." However, some observers believe the advertising strategists will have to go far to top TWA's old "Jetstream" designation for the Lockheed 1649A Constellation, which reportedly attracted many passengers who believed they were buying space on a jet.

ALTA Asks Congressional Action To Define CAB Intrastate Authority

Washington—Congressional action to clarify Civil Aeronautics Board authority to regulate intrastate operations of local service airlines is being sought by the Assn. of Local Transport Airlines.

Proposed legislation, aimed at resolving controversies that arose after several state regulatory bodies refused on the strength of Board orders to permit airlines to delete intrastate services, will be submitted to CAB in the next few weeks (AW Oct. 31, p. 39).

The gravity of the problem, which has forced Bonanza Air Lines and Frontier Airlines to retain uneconomical intrastate routes despite CAB orders permitting their deletion, was highlighted in a recent meeting between ALTA and the Board.

Bonanza cited the high cost of having to retain its services into Hawthorne and Tonapah, Nev., under a direct order from the state Public Service Commission, and told the Board that "if something isn't done to cut this Gordian knot, Bonanza will be the first all jet powered airline in America to go back to piston operations."

Bonanza called attention to the lengthy legal battles still in process between Bonanza, Frontier and American Airlines and the regulatory bodies of Nevada, Nebraska, and Illinois. It urged legislation that would establish CAB's authority in these matters as pre-eminent. Attempts to settle the issues on a case by case basis in court, Bonanza said, would result in "years and years" of litigation.

On the basic premise that CAB's authority over local service operations would pre-empt any state control of transportation, Bonanza explained that it dropped service into Hawthorne and reduced flights into Tonapah, in August of 1959, after being authorized to do so by the Board. It contested a state order to reinstate the service, but its protest was rejected last February by a Federal Court ruling that Bonanza had failed to exhaust all of its administrative appeals.

Bonanza told the Board it has decided against appealing the decision to the U. S. Supreme Court because of the risk that the high court might reaffirm the decision or issue an opinion that would result in further litigation.

On the question of regulating airline schedules, Bonanza said it also disagrees with state interpretations of congressional intent. Working of the Federal Aviation Act, which the airlines interpret as permitting them to control their schedules, is being regarded by state regulatory bodies as meaning that since CAB is not empowered to control this phase of airline operations, schedule frequencies may be determined by the states, the airline said.

"You can imagine the chaotic situation that could arise," a Bonanza spokesman warned the Board, "if 36 or 37 states that have this power start to regulate schedules."

Bonanza recommended an amendment to the Aviation Act as the most practical means of settling the growing conflict between CAB and state regulatory bodies. It said the problem is a "giant boa constrictor . . . in the Garden of Eden of the local transport industry," which could eventually "thwart and frustrate" Board efforts to improve local service operations.

Foreign Airline Control

Washington—Flight Engineers International Assn. urged the Federal Aviation Agency last week to seek legislation for greater control over foreign airlines operating into the U. S. The union said the request was made after it received reports that the Aeronaves de Mexico DC-8 flight which crashed at New York's Idlewild Airport Jan. 19 violated safety regulations by failing to have a licensed flight engineer in the crew. FEIA said it also had reason to believe the aircraft was not given a preflight inspection.

CAB's Formal Order of Approval Will Permit United-Capital Merger

By L. L. Doty

Washington—A tentative Civil Aeronautics Board decision last week approving the Capital Airlines-United Air Lines merger agreement will be followed by a formal order within the next three weeks that will open the way for final consolidation of the two companies.

Issued in the form of a press release, the announcement of the Board's vote does not constitute a formal decision and, thus, does not legally permit the two carriers to take actual steps toward merging. Nevertheless, because of its swift action, CAB has met United's Feb. 1 deadline by giving virtual assurance that the final decision will approve the merger subject to three conditions, none of which will stand in the way of merging the two airlines.

United had reserved the right to drop the merger if Board approval was not granted prior to Feb. 1. Effective date of the merger will be 30-60 days after CAB's final decision so that the new airline, which will be the nation's largest domestic trunkline, probably will emerge no later than mid-April and possibly as early as mid-March.

Here are the conditions which the CAB attached to the merger transaction:

- **Labor protective** provisions.
- **Valuation of assets** to be acquired by United from Capital will be limited for rate-making and accounting purposes.
- **Mohawk and Allegheny** will be protected in certain markets.

Compliance Expected

There was no elaboration of the conditions in the press release, but officials of both carriers feel that all three can be met without complicating the transition of two companies into a single organization. Both airlines have already agreed to take all necessary steps to protect employe seniority and provide severance pay or moving costs for displaced personnel.

Limitations in the valuation of Capital's assets were expected, and the condition calling for protection of the two local service carriers in certain markets can be met without objection since both trunk carriers have been eager to eliminate local service markets from their route structures.

Board Members G. Joseph Minetti and John S. Bragdon voted to approve the agreement under the three conditions but asked for an investigation to determine whether Capital's certificate authority "in certain markets on Route 51" should be "retained by United, terminated or transferred to another carrier." Route 51 covers virtually the entire Capital route pattern between New Orleans and Miami and northern cities.

The minority view is generally interpreted to pertain directly to the New York-New Orleans route, since it was this route segment which both Delta and Eastern said could not absorb the additional competition which United would provide on it.

Meanwhile, a 10-man United-Capital Merger Planning Committee is meeting every other week as an initial step toward the development of plans for a combined company and for short- and long-term schedule planning. A Merger Training Subcommittee has been formed to plan indoctrination and training of Capital personnel in United policies and procedures. United employes are being familiarized by the subcommittee with the programs developed for the enlarged organization.

One Possible Barrier

One unanticipated barrier stands in the way of the merger. United has stated that it may abandon the merger if at least 85% of Capital Airlines' 4¼% convertible debentures are not deposited under the plan to exchange 20 shares of United common stock for each $1,000 face value of the debentures. So far, about 46% have been received.

United has extended until Apr. 30 its offer to make the exchange. Previously, the offer was extended from Dec. 31 to Jan. 28. It has been estimated that holders of Capital's debentures will get some 60% of the face value of the securities.

The Board's press release decision came exactly 30 days after the examiner's initial decision and less than six months after the original application for the merger was filed with the Board (AW Aug. 8, p. 40). The success the two carriers have had in obtaining such expeditious treatment from the Board could encourage other trunklines to take similar action as a means of preventing financial hardship. Only other pending merger is that proposed between TWA and Northeast.

The United-Capital merger was undertaken when Capital's Board Chairman, Thomas Neelands, approached United with the proposal as a means of resolving Capital's financial dilemma which originated with a default on notes held by Vickers-Armstrongs, British manufacturer of the airline's Viscount transports. The British firm launched foreclosure proceedings against Capital.

Under the merger plan, as filed with the CAB, each share of Capital common stock would be exchanged for one-seventh of a share of United's common stock, plus a warrant entitling the holder to purchase three-fourteenths of a share of United stock at $40 per share during the next five years. Stockholders of both companies have approved the merger.

Vickers' Terms

Vickers has indicated it will withdraw its foreclosure suit under a plan which calls for the return of 15 Capital Viscounts to Vickers—leaving Capital with a fleet of 41 Viscounts—in part payment of the Capital indebtedness. Vickers will also get 159,000 shares of United 5¼% $100 par value preferred stock, 60,000 shares of United common stock and stock purchase warrants for 200,000 shares of United common stock at $45 per share, purchasable during the next 7½ yr. At mid-week, United common stock was quoted on the New York Stock Exchange at 39⅞—close to the 1961 high of 40⅛.

It has been estimated that under the plan, Vickers will get about 60% of the face value of its notes, which total $33.8 million.

Meanwhile, United last week reported net earnings of $6.6 million and a gain of $4.5 million on aircraft sales for the year 1960.

Combined total of $11.1 million in earnings and capital gain compares with a 1959 net profit of $10.2 million and a gain from the sale of equipment of $3.5 million. Operating revenues for the year totaled $379.1 million, highest in United's history and 15% above the 1959 level. Operating expenses totaled $363.6 million against total expenses of $308.3 million in the previous year. The airline said that the addition of 30 turbojet transports to its fleet during 1960 resulted in a 43% increase in depreciation and amortization expense.

Eastern Asks Review Of CAB Fare Decision

Washington—Eastern Air Lines has asked the U. S. Court of Appeals to review the Civil Aeronautics Board's decision in the General Passenger Fare Investigation and order more comprehensive action.

Eastern wants the Court to order the CAB to "act upon the standards which it has set" and make findings and recommendations on the lawfulness of present fares, then set lawful fares in accordance with their findings.

Controllers Want Bigger Voice in FAA

By David H. Hoffman

Washington – Mounting pressure within the Federal Aviation Agency probably will force Najeeb Halaby, its new administrator, to make clear the role its controllers will have in developing a more reliable air traffic control system.

Working under the Bureau of Air Traffic Management, a majority of the 12,000-odd FAA controllers believe the agency has awarded overwhelming priority to projects sponsored by its Bureau of Research and Development.

Because they feel their pleas for state-of-the-art improvements in the traffic control system have been neglected, the federal employes of ATM are resorting to increasingly unorthodox means in an effort to focus high-level FAA attention on their complaints.

Symptomatic of the frustration expressed by rank and file controllers is a protest addressed to the chief of the Washington National Airport tower and signed by 45 approach control and tower cab operators on Dec. 20, four days after the New York DC-8-Constellation midair collision (AW Jan. 16, p. 39).

In their letter, the controllers condemned the practice of using intersections formed by the radials of two visual omnirange stations to establish primary feeder fixes for an airport's instrument runway.

Privately, they expressed alarm because only about 10 naut. mi. separate McLean and College, the two intersections at issue. After observing the blips of numerous aircraft overshoot the two fixes since their establishment in October, the controllers wrote:

"It is difficult to understand why the present concept of a two feeder fix operation remains in effect when sufficient evidence has been on file in the facility since Oct. 20, 1960, to glaringly reveal that imperative action should be taken immediately to discontinue the present operational concept before a similar tragedy occurs in the Washington airspace . . ."

Holding that their superiors in the tower were in agreement, the controllers asked why no logical explanation had been offered "to justify the present frightening procedural method of operation." Although they refused to make their letter public, the group urged the tower chief to take "drastic action" in remedying the situation.

On Jan. 19, FAA responded to the complaint and eliminated McLean as a holding point for aircraft awaiting approach clearances to Washington National. Jurisdiction of Washington approach control also was extended to include higher altitudes and additional areas, thus offering inbound aircraft more precise radar coverage.

The complaint expressed by the Washington controllers was aimed at the structural organization of ATM and emphasized the problems encountered by line personnel in funneling procedural recommendations upward through channels. As such, it was not directly concerned with the system used by FAA to fix priorities for allocating air traffic control funds either to ATM or to the Bureau of Research and Development.

But officials speaking for the Air Traffic Control Assn., which represents about 80% of FAA's controller force, feel that the Washington petition underscores their membership's "attitude of hopelessness." And this attitude, according to ATCA, is a product of the system because ATM lacks authority to define its current operational requirements and has little voice on questions of fiscal priority.

To clarify the relationship between ATM and BRD in initiating traffic control system improvements, former FAA Administrator Elwood R. Quesada issued Agency Bulletin 61-1 about a week before he left office. Bulletin 61-1, however, has generated its own measure of controversy, for FAA bureau chiefs are now at odds over what the document means, despite its specific wording.

Key paragraph of the bulletin reads: "The Bureau of Research and Development shall be responsible for . . . identifying and substantiating the need for modifying or improving planned and installed air navigation, traffic control, communications, and related equipment, facilities and systems" (AW Jan. 30, p. 39).

This would seem to reduce the procurement role of ATM rather than expand it. But David Thomas, ATM's director, told AVIATION WEEK that 61-1 has not been implemented within FAA and that the consensus in the bureaus concerned is that the bulletin will not radically reshape past practice even if it is. The new 61-1, Thomas said, has an "excellent chance" of being rewritten or perhaps rescinded.

Regardless of 61-1's fate, the question—who at FAA should have prime responsibility for increasing the air traffic control system's over-all reliability—is expected to undergo new scrutiny during the inquiry ordered by Sen. A. S. Mike Monroney (D.-Okla.) and scheduled for Feb. 20.

As an indication of what may be offered by traffic controllers, Frank M. McDermott, ATCA's executive director, believes that FAA should be reorganized in a manner that would raise ATM's influence in the agency. At the present time, according to McDermott, "the Bureau has no direct authority to state its requirements and no procedure to ensure that these requirements will be met—in terms of personnel qualifications and standards, engineering support, research direction and general housekeeping."

Specifically, McDermott charges that necessary and proven techniques have been shelved, among them: widespread installation of computers to handle clerical chores in traffic control centers, common radar rooms to ease the problems involved in radar hand-offs between center and approach control facilities, bright radar displays and improved beacon-transponder equipment.

The six-hour work-shift experiment scheduled to begin this month at Washington's control tower and center demonstrates that ATM is aware of controller discontent. By observing this trial program for 90 days, ATM seeks to learn how much strain—in dollars and in increased personnel requirements—will be imposed on the system if two hours of the controllers' eight-hour day are reserved for lunch, briefing and debriefing of transition shifts and at least one hour of concentrated refresher training.

Traffic Control Changes

Washington—The Federal Aviation Agency's Bureau of Air Traffic Management is planning to raise the 180-kt. holding pattern speed limit for jet transports and to enlarge pattern dimensions to accommodate faster aircraft.

A response to pilot complaints that Douglas DC-8 and Boeing 707 series aircraft are harder to control at low airspeeds, the change is one of a series under consideration following the Dec. 16 midair collision over New York.

At Cleveland, Washington and New York—all terminal areas within FAA's Region I—the Agency has revised the manner in which visual omnirange intersections are used as primary feeder fixes for instrument runways. In addition, FAA is considering a 250-kt. speed limit for all aircraft within 50 mi. of destination airports.

Earlier, FAA announced an intention to require distance measuring equipment on airline transports (AW Jan. 2, p. 26), and also decided that United Air Lines should place increased emphasis upon air traffic control procedures in its pilot training programs (AW Jan. 30, p. 41).

This latter requirement, however, probably will be broadened to include publication of an Air Traffic Control Primer for distribution to all airline pilots and laying stress on services offered by radar and on high-density traffic procedures in general.

Africa Becoming Strong Aircraft Market

By Robert H. Cook

Washington—Africa is becoming a great potential market for aircraft because of its growing number of new nations, and U.S. manufacturers can capture a large share of this future business, Commerce Department said last week.

A market survey made by the department's Business and Defense Services Administration as part of a world civil aviation survey cited tentative plans of the new states to form their own flag carriers, using long-range turboprop and turbojet aircraft, as well as initial studies by the Conference of Independent African States (CIAS), which would lead eventually to a complex network of domestic routes across the African continent.

Domestic and local service operations hold the greatest promise of sales volume for U.S. manufacturers, the survey said. Many new states may be forced to defer plans for international services until they learn more about local requirements and the problems of competitive service. CIAS has stressed these points and has advised the states to give top priority to developing adequate internal air services, then move on to a trans-African service by an airline using equipment pooled by the states.

The percentage of future aviation business that the U.S. can hope to obtain as a result of Africa's changing economic and political status was not predicted by the survey. Attempts to do so are clouded both by the rapidity of the independence movement and by the close ties that have existed for years between many African states and European countries.

Such ties could be continued, resulting in the purchase of new European aircraft, while foreign investments retained in African carriers could help European nations dispose of surplus piston equipment in the African market.

More than 54% of the total African civil air fleet of 1,800 aircraft is U.S. manufactured. If the market for new U.S. aircraft should be hampered by the sale of surplus aircraft, the survey said, "a tremendous market potential" might arise for spare and replacement parts.

Most of these are being imported from the U.S. now.

Light, Medium Markets

The greatest immediate opportunity for future sales expansion lies in the growing market for light and medium utility aircraft, which accounted for 12% of the total $6.6 million in U.S. aviation exports to Africa in 1957 and 38% of the $2.5 million of 1959 exports, the survey said. Deliveries of these types continued to grow last year and accounted for a higher percentage during the first six months than for the entire year of 1959.

Import duties and regulations imposed by the African nations on U.S. purchases should not hamper sales, the survey said. Twin engine utility transports have very little competition in Africa, and single engine aircraft "almost none," the survey said. It said sales of general purpose aircraft could be greatly expanded by offering suitable prices and terms and by "thoughtful, efficient and personalized competitive merchandising."

Analysis of basic data supplied by the U.S. Foreign Service, supplemented by Commerce Department statistics, was used in the survey to arrive at these market predictions for the following key areas of Africa:

• **British East African** territories of Kenya, Uganda and Tanganyika are served by the East African Airways Corp., owned jointly by the four governments. Operated on a semi-independent basis, the airline supplies the only local scheduled service in the area, and has international flights to London, Karachi, Bombay and Johannesburg.

Fleet of 16 aircraft includes four de Havilland DH.89A Rapides, which it expects to dispose of along with two of nine Douglas DC-3s; and three Canadair C.4s. Future plans call for the disposal of all DC-3s when a replacement is found. Canadairs used on international routes were scheduled to be transferred to domestic service upon acceptance of two de Havilland Comet 4s last year.

An ideal DC-3 replacement would be a twin-engine aircraft holding 6-10 passengers. U.S. and British aircraft are preferred by EAAC and several smaller operators in the territories because of familiarity and availability of maintenance facilities.

Potential Market

Potential market for surplus piston engine aircraft is very limited within the territories and EAAC, which acquired its DC-3 fleet after World War II, is expected to operate them for a long time.

In the utility aircraft field, preference is for U.S. models. Major U.S. manufacturers have agencies in Kenya. More than half of the 118 general aviation type aircraft being used are of U.S. manufacture and this market could expand if the government continues its program of encouraging aviation development and the economies remain stable.

• **Ethiopia, through its flag** carrier, Ethiopian Airlines is considered one of the most promising markets because of its interest in developing a trans-Africa service. Its fleet of 19 U.S.-made aircraft provides scheduled international service to Europe plus a broad pattern of domestic flights. Future plans call for purchase of new turboprop and turbojet equipment for use on both international and trans-African routes, ruling out any market for U.S. surplus piston engine aircraft. On the basis of the country's past favorable relations with the U.S. it is expected that Ethiopia will make any new aircraft purchases here. New airports planned for the interior are also expected to increase the light aircraft market.

TWA Stockholders to Reconstitute Board

New York—Trans World Airlines last week set Feb. 28 as the date of a special stockholders' meeting asked by its new voting trustees seeking to reconstitute TWA's board of directors.

The trustees, named in December to vote the 78% of TWA stock formerly held by Hughes Tool Co., failed to get a quorum of TWA directors for a meeting last month to consider the board reshuffle. The trustees want six new directors, selected by themselves, to be elected to the board.

Ernest R. Breech and Irving S. Olds, two of the three trustees, issued a statement last month calling for the stockholders' meeting and said the board reconstitution is necessary ". . . to protect all of the stockholders of TWA," the public, and TWA's employes. Breech is one of the trustees' selections for a new director.

Breech and Olds also said they had been informed by a Hughes Tool representative that interests he represented would not be best served by a board reconstitution as proposed. This advice reportedly was received just before the directors' meeting was scheduled to consider the matter. The lack of a quorum prevented the meeting from taking place.

At last week's meeting of the executive committee of TWA's board, Feb. 6 was set as the date of record for stockholders participating in the Feb. 28 meeting in Kansas City. The committee said reconstitution will involve electing the 12 present directors and six new directors.

• **Federation of Rhodesia** and Nyasaland, while self-governing to a degree, is recognized as a United Kingdom territory for the purposes of international air transportation. Central African Airways provides both internal service and international service to the U. K. with a fleet composed of four Vickers Viscounts, two DC-3s and five de Havilland DHC-2 Beavers. The carrier has no immediate plans for retirement of equipment and because of subsidization, it probably would favor British equipment in any future purchase. A small market exists for DC-3s and light aircraft, but is handicapped by the preferential position of U. K. suppliers.

• **Republic of Liberia** holds little promise of a profitable market for U. S. surplus piston equipment but is expected to continue its preference for U. S. light aircraft.

• **Nigeria, with the largest** population in Africa—32 million—offers one of the highest growth potentials. West African Airways Corp., formed when the state gained its independence from Great Britain last year, is owned in partnership with British Overseas Airways Corp. It provides internal, inter-African and international services. Future importance of Nigeria in Africa's aviation growth is strengthened by the strategic location of its main airport at Lagos, which can serve as a terminal for trans-African flights and a connecting stop for air routes down the west coast of the continent. WAAC, also known as Nigerian Airways, operates eight de Havilland Herons, one Dove and seven DC-3s, none of which is scheduled for disposal. An anticipated rise in demand for West African service could lead to the purchase of several small turboprop aircraft but the state's past close ties with the British and its new found independence make its choice difficult to predict.

A possibility exists that the airline might require two surplus four-engine transports to replace the Bristol Britannia's now leased from BOAC for use on a Lagos-London route. This would permit WAAC to maintain its international service as a national operation.

Largest sales potential is seen in the light aircraft field, or possibly in helicopters if maintenance is not too much of a problem. Twin-engine aircraft are particularly favored because of the long distances between adequate airports.

• **Union of South Africa,** an independent member of the British Commonwealth, has 616 aircraft registered. All but 119 are U. S. made, including 20 of South African Airways' total fleet of 27. The national flag carrier also has ordered three Boeing 707 turbojets for use on routes linking it with Europe and Australia.

Except for the Boeing purchase, few firm plans for buying aircraft have been mentioned either by SAA or the few nonscheduled and charter operators within the Union. A fairly good market for DC-3s and DC-4s may develop if the traffic growth continues, but possibilities are slight for the sale of any large surplus U. S. piston aircraft.

Nearly all the registered light aircraft in the Union are of U. S. make and the greatest sales potential probably is in this area. U. S. utility aircraft of a two- to four-passenger capacity were reported to be priced better than the medium-size private aircraft, but medium-size U. S. planes have retained a sales lead over competing British models.

Soviets Building New Terminal in Siberia

Moscow—Construction of a new air terminal which Soviets say will be "one of biggest in Asia" has begun near Novosibirsk, the Soviet Union's so-called scientific city in Siberia.

Tass reported that the terminal will be able to accommodate several hundred passengers hourly, adding "experience of the best Soviet and foreign air terminals has been taken into account with a view to saving passengers' time when registering their documents and luggage."

Terminal will be some 600 ft. long and will occupy 64,560 sq. ft. Planes will be boarded via a protruding ramp from the second floor of the terminal.

Novosibirsk, site of the Siberian branch of the Academy of Sciences and many institutes, generally has been closed to foreigners but terminal construction plans point to a possible change in this policy.

CAB Will Investigate Frontier Traffic Rate

Washington—Frontier Airlines' route between Denver, Colo., and Omaha, Neb., may be abolished along with service to 13 other cities as a result of a Civil Aeronautics Board investigation launched last week under the use-it-or-lose-it policy.

These services were authorized two years ago in the Seven States Area Case, subject to periodic traffic reviews by CAB. The Board stipulated that the authority could be retained only if an average load of five passengers per flight for route segments and a boarding rate of five passengers daily at each city were maintained.

Based on an 18 month study of the Frontier route system, the Board found a majority of the cities awarded to the carrier in the Seven States Case failed to meet minimum traffic standards. Cities where service may be canceled under the investigation include Aliance, Betraice, Chadron, Imperial, Kearney, McCook and Sidney, Neb.; Hot Springs and Lemmon, S. D.; Dickinson, N. D.; Newcastle, Wyo.; Sterling, Colo., and St. Joseph, Missouri. Average daily passenger loads originating at these points ranged from 0.77 at Hot Springs to 4.16 at Kearney.

Along with its investigation of the airline's Denver-Omaha service, which produced an average of only 4.6 passengers per flight over a one year period, CAB included a portion of Frontier's Segment 10 service between Rapid City, S. D. and Caspar, Wyo., which averaged only 1.5 passengers per flight.

In addition to the routes awarded in the Seven States Case, the Board is studying possible reduction of Frontier's service into Cheyenne.

Western Asks CAB For Hawaii Route

Washington—Western Air Lines has asked the Civil Aeronautics Board to reverse its stand on the Transpacific Route Case and make the domestic route awards planned before President Eisenhower intervened.

The Board has said that since President Eisenhower disapproved major portions of the international phase of the decision just before he left the White House, it is necessary "to give further consideration to the domestic phase of this proceeding . . ." (AW Jan. 30, p. 38).

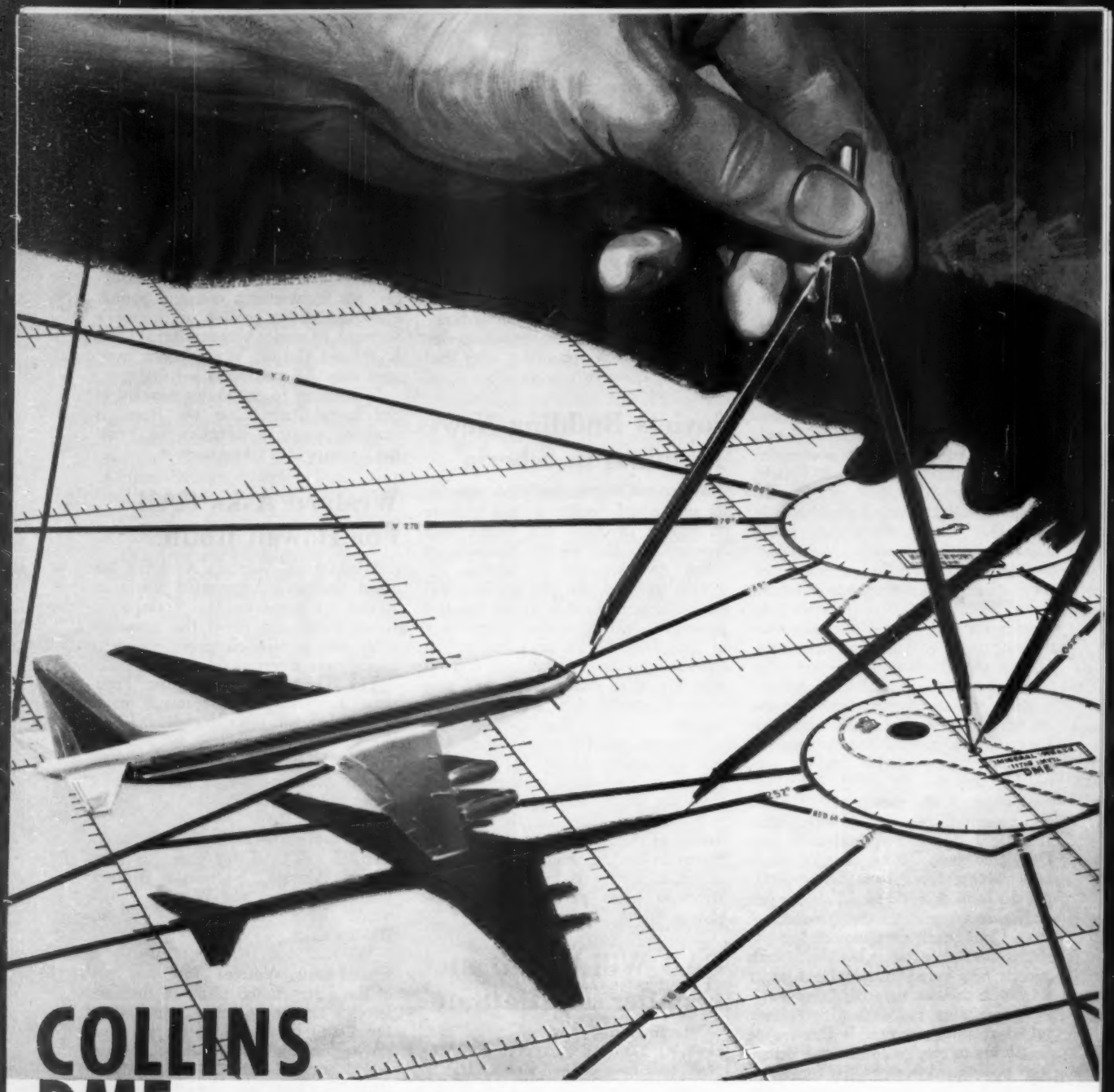
New operating authority was recommended by CAB for Pan American World Airways, Northwest Airlines, United Air Lines and Western, which would have received a mainland-Hawaii route.

Western said that route awards to United and Western were not part of the international phase of the case. In view of the unanimous decision of the Board on the need for increased service from the mainland to Hawaii and President Eisenhower's admission that he had no jurisdiction over domestic route matters, Western urged the Board to reconsider its decision on the domestic phase of the case and award the routes.

Capital, Trans-Canada Inspecting Viscounts

Washington — Capital Airlines and Trans-Canada Airlines, acting on Vickers-Armstrongs recommendations, are inspecting their fleets of Vickers Viscount turboprop transports for spar cracks (AW Jan. 16, p. 41).

The inspection program, which began four weeks ago, was urged as the result of spar cracking discovered in the original Viscount 700 series.



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The accuracy of a pilot's navigation in today's jet age is as good as the system he uses. The Collins 860E-1 DME permits the pilot to fly from point to point with a minimum of delay and increases his efficiency with precise navigation.

Instantaneous, accurate and continuous position information is provided the pilot and ground controllers throughout the flight. DME also permits pilots to easily compute ground speed and ETA's. DME facilitates instrument landing procedures. It enables use of holding patterns that provide both horizontal and vertical separation of aircraft. DME provides additional safety and pilot assurance under all flying conditions.

Economically, DME makes sense, too. DME reduces in-flight time and facilitates straight-in letdowns from cruising altitudes. In flight, more positive holding patterns can be maintained.

Collins 860E-1 DME features: Improved lock-on and a narrow band IF amplifier to assure adjacent channel rejection and prevent false lock-on; modular plug-in design to simplify maintenance and allow for possible future modification; numerous test points to facilitate rapid fault isolation; direct flow cooling system and silicon power rectifiers to minimize heat affect and provide optimum reliability; accurate within ±0.1 nautical mile for ranges up to 5 miles and ±0.2 nautical mile for ranges between 5 and 197 nautical miles; FAA TSO'd; and shock and vibration resistant construction.

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Hawaiian, Aloha Airlines Urging Common Fares From the Mainland

Honolulu—Need for common fares from the mainland to all Hawaiian points beyond Honolulu to arrest the decline of air traffic to the state's outlying islands was the pivotal issue in hearings held here late last month by the Civil Aeronautics Board.

The state and the two inter-island airlines—Hawaiian and Aloha—initiated the proceedings in a move to reverse a 1950 CAB decision outlawing a common fare structure between the West Coast and all terminal points within Hawaii.

Currently, Honolulu on the island of Oahu is the only air gateway to Hawaii, and passengers from the mainland must pay from $24 to $42 for round trips to any of the five so-called Neighbor Islands in addition to the mainland-Honolulu fare. Under the proposed common fare plan, pro rated inter-island fares would be drawn from the basic mainland-Hawaii fare collected by the trunk carriers.

Chief Arguments

Here are the chief arguments presented to Board Examiner Thomas L. Wrenn by witnesses for Hawaii and the two airlines during the eight days of hearings:

• **Federal and state aid** is required to build a tourist industry on the Neighbor Islands, where both jobs and population have been diminishing sharply during the past decade.

• **Stimulation of travel** to these islands would encourage mainland and local capital to invest in expanding resort facilities outside of Honolulu's Waikiki area, which is already overcrowded.

• **Aloha and Hawaiian,** which compete point-to-point throughout their limited route system, need an inter-island tourist boom before either can show satisfactory net earnings. Aloha, which is off subsidy, barely broke even last year. Hawaiian has needed subsidy since mid-1958.

• **Tourist traffic to Hawaii** has been increasing at a 20% annual rate since World War II but the percentage of tourists traveling to the Neighbor Islands has actually declined. It was argued that mainland-Hawaii carriers—Northwest, Pan American and United—could absorb the small loss resulting from the common fare structure, since such fares would generate sufficient traffic to offset the losses.

Aloha estimated that common fares would generate an additional 90,000 passengers in 1962 to bring the total to 582,000 and provide $692,000 in revenues. United calculated in an exhibit that common fares would result in losses exceeding $1 million annually. Hawaiian countered with a contention that the common fares would bring United 10% more traffic for a net gain of $185,000.

During the course of the hearings, Wrenn gave some indications of the elements of the case which he will consider in forming an initial decision. He questioned whether the cost of inter-island fares is actually a major deterrent to travel beyond Honolulu and asked if the state and private industry were preparing to make sacrifices and contributions of their own to Neighbor Island development schemes.

Wrenn wanted to know if costs of tourist facilities are in line with amounts budget-minded tourists could afford and whether there will be adequate tourist facilities to accommodate the predicted flow of visitors. He also asked if the two airlines and the state are willing to back common fares with restrictions on stop-overs and class of service.

Three Conditions

In this connection, the Honolulu Chamber of Commerce attached three conditions to its endorsement of the common fare structure: Hawaii-mainland fares should not be increased, stopovers at Honolulu should be permitted without extra charge and common fares should be applied to both tourist and first-class travel.

Pan American proposed a formula which would provide an $8 to $14 saving on round-trip tickets purchased for travel between the mainland and Honolulu and beyond to the Neighbor Islands.

TWA Installs 707 Ventral Fins Under Boeing Program

Trans World Airlines is making the Boeing-recommended modifications to its fleet of 707s including installation of a ventral fin (right). Fin is designed to improve directional stability at high angles of attack, and also to limit the angle of rotation by providing a bumper if the aircraft's nose is lifted too high on takeoff. Other modifications in Boeing's "flight characteristics improvement program" (AW Feb. 22, p. 39) include a 3-ft. increase in height of vertical stabilizer, and full rudder boost.

RELIABLE HUSKIE... WELCOME SIGHT IN MISSILE SUPPORT

The kind of support a missile site may need in an emergency may be technicians, equipment, liaison or surveillance.

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Fokker Plans Follow-On Versions of F-27

Amsterdam—Fokker is planning three potential follow-on versions of its F-27 Friendship short-range turboprop transport, the company's first postwar commercial product, for possible production. They are:

• **STOL fitted with double-slotted flaps** and spoilers plus increased aileron and rudder power. For military operations, Fokker officials say the aircraft would have approximately the same takeoff and landing characteristics as those of the de Havilland Caribou—ability to clear a 50-ft. obstacle within 700 ft. of its starting point. To meet normal civil requirements, however, the figure would more than double. Powerplants would be advanced versions of the Rolls-Royce Dart. The flap and spoiler arrangement already has been installed on a standard Friendship for flight test purposes.

Increased Length

• **Stretched fuselage version** carrying between 48 and 60 passengers, depending upon the seat pitch, as opposed to the 40 for the present Fokker configuration and 44 for the Fairchild F-27 produced under license in the U.S. In the stretched version, fuselage length would be increased by a total of 88.6 in.—53.2 in. in front of the wing 35.4 in. aft of the wing. Normal powerplants would be two Rolls-Royce Dart RDa. 7/2s with 1,910 shp. each, as compared with the 1,720 shp. of the Dart 6 which powers the current F-27-100 series. The higher-thrust RDa. 10 with 2,400 shp. also is being offered to operators who fly regularly under severe altitude and temperature conditions.

• **High-density version** designed to carry 52 passengers. In this configuration, the fuselage length would be stretched from the present 30 ft. 10 in. to 33.5 ft., and special "high density" seats with a 30-in. pitch would be installed. The "high density" seats specified by Fokker were designed by L. A. Rumbold & Co., Ltd., of London, weigh 37 lb. each and include foldable back and armrests, a foldable table and space for magazine and lifejacket stowage.

Firm Orders

Future of any and all of these proposals depends upon Fokker's success in obtaining firm orders. H. C. van Meerten, Fokker technical director and a member of the board of directors, estimates that between 20 and 25 orders for a specific type should be on hand before that particular aircraft is placed in production.

All three designs, however, have undergone extensive wind tunnel testing, and van Meerten estimates that initial deliveries of the high-density version could begin within 14-15 months from the start of production, which, he adds, could begin "almost immediately." STOL and stretched-version deliveries, van Meerten says, could be made within two years of an order.

In the 48-passenger configuration of the stretched version, seat pitch would be 35.5 in., as compared with 30 in. in the 60-passenger aircraft, which also would incorporate the Rumbold seat.

Estimated crusing speed of the RDa. 7/2 powered stretched version would be 249 kt. at a near-maximum gross weight of 39,000 lb. and an altitude of 23,000 ft. Maximum range with a full passenger and luggage load—and allowing time for three-quarters of an hour holding at 5,000 ft. and 5% on fuel without diversion—is 850 naut. mi.

Cruising speed of the RDa. 10 version is slightly higher—270 kt. with full payload—but increased fuel consumption cuts the range to an estimated 810 naut. mi.

Each aisle of the 48-seat configuration has 12 rows of two-abreast seats. The 60-passenger version, with its 30-in.-pitch seats, has 15 rows on either side of the fuselage.

Forward cargo capacity in the 60-seater also is reduced from 109 to 88 cu. ft.

Capacity payloads and stage lengths for the RDa. 7/2 version range from a maximum of 14,370 lb. for a 100 naut. mi. flight to 9,400 lb. for an 800 naut. mi. schedule. Similar figures for the RDa. 10 configuration are 13,000 lb. and 100 naut. mi.; 9,120 lb. and 800 naut. mi.

High-Density Version

Plans for the 52-passenger high-density version call for the aircraft to be powered by two Dart RDa. 7 Mk. 528 engines of 2,105 eshp. each. Takeoff requirements at sea level are estimated at approximately 6,000 ft.

Maximum cruising speed is about 260 kt.

Range with a full passenger and cargo load is given at 910 naut. mi., including a 200 naut. mi. alternate plus 45 min. holding time. Capacity payload is 10,400 lb.

In both the high-density and stretched versions, the door to the rear cargo compartment would swing outward as a space saving measure rather than inward as it does on present F-27 models. Outward swinging doors probably also will be adopted on late production models of the standard F-27.

If any of the three versions go into

FOKKER F-27 short-range turboprop Friendships are shown in varying stages of completion on the company's production line.

Now, Rolls-Royce approves Texaco Synthetic Aircraft Turbine Oil 35 for its Dart turbo-prop engines

Behind this approval lies eight years of synthetic turbine oil development and testing.

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actual production, Fairchild may be offered a license to produce the aircraft within the U. S. if, van Meerten says, "they would agree to share in the development costs."

Fokker thus far has received orders for a total of 86 standard F-27s, of which approximately 50 have been delivered to military and commercial operators in 13 countries since the first production model rolled out in March, 1958. Fairchild, producing the transport under license, has delivered another 80 aircraft. Current production rate at Fokker is approximately 2½ airframes per month.

Breakeven Point

Van Meerten estimates the breakeven point on Friendship production at approximately 100 aircraft before all development costs are written off and says confidently "we're sure that we will pass that." Over-all, with the variety of projects it has on hand plus its tie-up with Republic Aviation Corp. in which the latter firm purchased about 33% of Fokker's stock last spring, van Meerten sees prosperous times ahead "for the next five years at least."

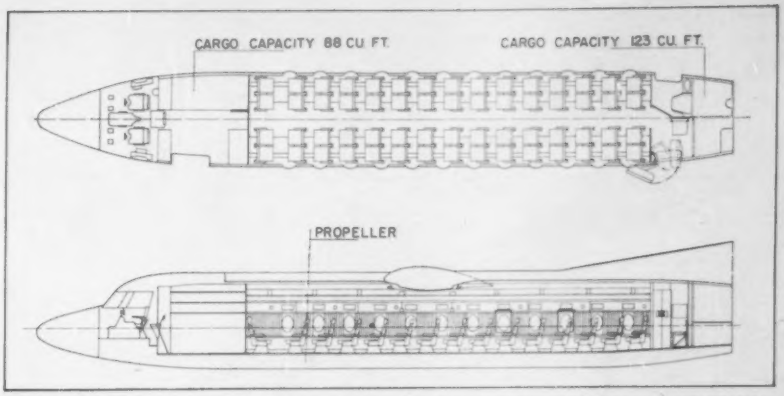
To try to make sure that matters are just as prosperous during the succeeding five years, Fokker is making extensive use of Republic research data as well as its own and is deep in the design of a variable sweep VTOL close-support fighter. The fighter, based largely upon Republic designs, will be entered into the forthcoming North Atlantic Treaty Organization for a VTOL fighter where it will face stiff competition from the West German industry (AW Jan. 9, p. 34)

If the Fokker proposal should be accepted by NATO, van Meerten says its final development and production would be shared with a number of other NATO nations in much the same manner as in the Lockheed F-104G and Raytheon Hawk anti-aircraft missile production programs now under way in Europe.

Team Leader

Fokker is the team leader of a consortium of firms scheduled to produce 375 of the 949 F-104Gs programed for production within Europe. It will be responsible for final assembly and flight test of all the aircraft produced by the consortium and hopes to roll out its first F-104G by early 1962. Space for the assembly line is now being cleared, and Fokker is in the process of producing the necessary jigs to the specification of master tools supplied by Lockheed Aircraft.

The company also is tooling to build components for the six-nation Hawk production program, and is currently delivering nacelle and wing sections to Breguet in France for incorporation in NATO's Atlantic ASW turboprop aircraft.



STRETCHED F-27 has seats for 60 passengers; fuselage length would be increased 88.6 in.

Formerly designated the N. V. Nederlandsche Vliegtuigenfabriek Fokker (Netherlands Aircraft Factory Fokker), the firm was founded in July, 1919, by the late Anthony H. G. Fokker, whose designs played a major role in the German air service in World War I.

His postwar designs were equally successful, and by 1939 firms of 22 nations held contracts for licensed production of Fokker aircraft, and a total of 28 air forces operated Fokker planes as standard equipment.

Wartime Losses

Fokker's Amsterdam plant was looted during the German occupation of World War II, many of its technicians were scattered, and almost all had lost out on the technological advances made in the U. S. and Great Britain during the war years. Consequently, the company began rebuilding slowly, beginning first with the construction of buses for the Dutch Railway System and then advancing on to a series of small aircraft, including the F-25 "Promotor" air taxi and the S-11, S-12 and S-14 trainers.

The company's real recovery, however, began with a contract to build a number of Hawker Sea Fury carrier-based fighters under license for the Dutch navy. This was followed in 1949 by a combined order from Holland and Belgium for the licensed production of 330 Gloster Meteor Mk. VIII jet fighters and for the construction of the Hawker Hunter F. 1.

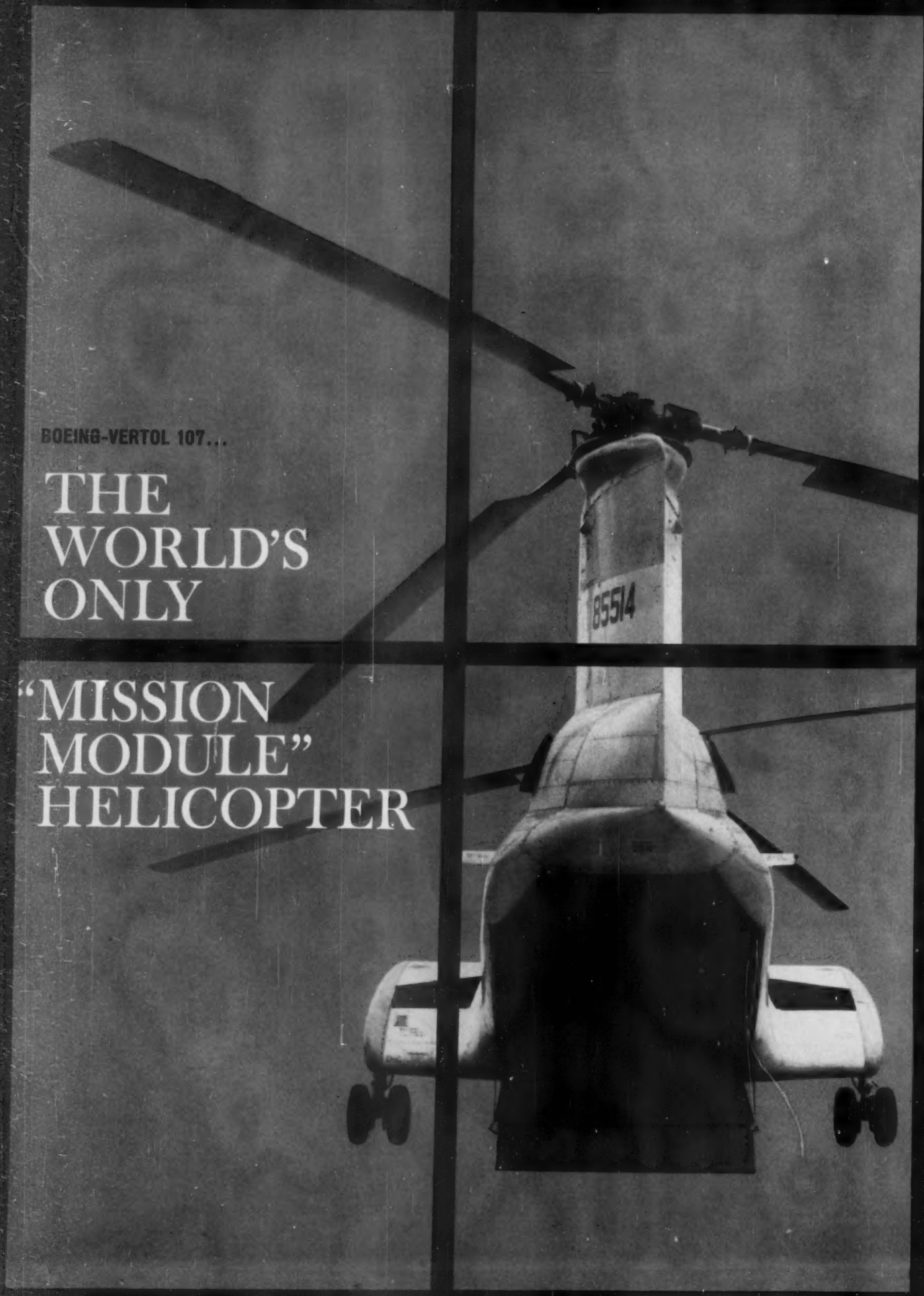
In a joint program with Belgium's Societe Anonyme Belge de Constructions Aeronautiques (SABCA) and Aviolanda, a total of 460 Hunters was produced. Of these, and computed on a man-hour basis, Fokker was responsible for approximately 260.

The last Hunter rolled off the line in March, 1959, and by this time Fokker was once again well on its way.

F-27 Takeoff and Landing Performances

Type	F-27-100 series Dart 6 engines		F-27 stretched fuselage version with RDa 7 engines					
Condition	ISA sea level		ISA sea level		ISA + 30C sea level		ISA 5,000 ft.	
Takeoff flaps	16.5°	0°	16.5°	0°	16.5°	0°	16.5°	0°
Takeoff								
Max. permitted weight lb. limited by:	36,500 climb	37,500 structural	41,000 arbitrarily chosen	42,000 structural	39,950 climb	42,000 structural	37,500 climb	40,900 climb
Resulting takeoff distance ft. (balanced when necessary)	4,075	4,750	4,030	5,100	4,460	5,780	4,490	6,460
Landing								
Max. permitted weight lb. (structural)	35,700		41,000					
Resulting landing distance ft. intended destinaton	3,440		3,750					

Note: V_T—1, 2 V_{s_0} based on SR 422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Whatever the mission, the performance-proved Boeing-Vertol 107 offers features unmatched by any other helicopter—150 mile-an-hour cruise speed . . . neutral directional stability at zero airspeed for any-wind hovering . . . a Vertol-developed stability augmentation system (SAS) provides fixed-wing aircraft stability which can be augmented with a trim system for automatic flight . . . tandem-rotor design that minimizes down-wash velocities . . . ability to land and take-off from water without special flotation gear.

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AIRLINE OBSERVER

► Look for European orders for the Boeing 727 medium-range jet transport within the near future, cutting into the potential market for the Sud Caravelle and the de Havilland DH-121. Hottest current prospects are Lufthansa and KLM.

► **Riddle Airlines' three AW 650 Argosy transports were grounded last week pending installation of elevators modified by the British manufacturer to eliminate stress problems. An air shipment of the modified control units was due late last week. Although Federal Aviation Agency did not order it, Riddle grounded the turboprop freighters as a precautionary move after discovering evidence of stress damage to the elevators' skin. Curtiss C-46 aircraft were substituted for the Argosies on the carrier's Logair runs.**

► Flight engineers and pilots will push for a Federal Aviation Agency regulation requiring the use of flight recorders on all training flights.

► **Watch for the Air Traffic Control Assn. to join forces with the Air Line Dispatchers Assn. and the Air Line Pilots Assn. in opposing any legislative or regulatory attempt to give tower operators final authority over takeoffs in marginal weather. Both the Federal Aviation Agency and Sen. A. S. Mike Monroney (D.-Okla.), have called for such a measure (AW Nov. 28, p. 52). However, tower operators among the 10,000 ATCA members are not prepared to assume responsibility for weighing the safety of each takeoff from their positions in the control cabs.**

► Recent Pan American tests on use of tropospheric scatter techniques for extending the range of VHF for air-ground communications beyond normal line-of-sight range indicate that two-way voice communications can be conducted over distances of more than 2,000 mi. with the assistance of radio ducts formed by temperature inversions. In tests conducted between California and Hawaii, Pan American was able to maintain two-way voice communications for distances of more than 1,000 mi. on 14 out of 40 flights.

► **International Air Transport Assn. has protested to the British Minister of Aviation against a proposed 33.3% increase in landing fees at United Kingdom airports effective April 1. According to IATA, the new fees would bring the total increase in the past four years to 125% at the lower end of the weight scale and 250% for the heaviest aircraft.**

► Sud Aviation is considering a Mark 10 version of the Caravelle medium-range jet transport incorporating 14,000-lb.-thrust Pratt & Whitney JT8D turbofan engines. More powerful engines and a stretched fuselage would cut takeoff requirements, boost the range to approximately 1,000 mi. and increase seating capacity by about 10 passengers.

► **Supporters of increased federal aid for airports now fear their proposed bills may be thwarted by members of the House Interstate and Foreign Commerce Committee whose seats are affected by the coming congressional reapportionment. Advocates feel that Sen. A. S. Mike Monroney's proposed legislation making $500 million available over the next five years has an excellent chance of passing the Senate. But because at least 17 Democrats and 11 Republicans on the House committee occupy seats involved in the realignment of districts that must follow 1960's census, airport aid proponents anticipate a generally conservative fiscal attitude because these congressmen will be cautious about heavy spending programs until they can assess their impact on the new districts.**

► United Air Lines plans to undertake extensive interior refurbishing and exterior repainting of Capital Airlines' 41 Viscounts on a one-plane-at-a-time basis after the two companies merge. Modification of the fleet is scheduled for completion by the end of 1961.

► **Railroads last week lost the first round in their latest battle to enter airline, trucking and shipping fields. An Interstate Commerce Commission examiner recommended denial of an application by Illinois Central and Southern Pacific to acquire a Mississippi River barge line. The case is considered a major test in the railroads' campaign for freedom to diversify.**

SHORTLINES

► **Airport Operators Council,** American Assn. of Airport Executives and National Assn. of State Aviation Officials has estimated that $1.1 billion will be needed during the next four years to improve present airports and build needed new airports. They say that $134 million in federal funds will be needed annually for the next four years to augment the $588 million which state and local agencies will spend for airport construction.

► **Compania Mexicana de Aviacion** and Guest Aerovias are working out an agreement under which CMA will lease a de Havilland Comet 4 turbojet transport to Guest for use on Guest's Mexico City-Europe route.

► **Continental Airlines'** turbine-powered fleet will account for more than 90% of scheduled seat miles after Feb. 11. Boeing 707 transports will account for 60.8% and Vickers Viscounts 30.6% of all daily seat miles.

► **Eastern Air Lines** flew 24.6-million ton miles of air freight during 1960, a 32.5% increase over the volume carried in 1959.

► **Ethiopian Airlines** began Douglas DC-6B operations last week into Lagos, Nigeria with the adoption of a revised schedule for the carrier's transafrican flights, which also serve Accra, Ghana and Roberts Field, Liberia.

► **Federal Aviation Agency** launched construction last week on its $1,747,000, 54,000-sq.-ft. air route traffic control center at Leesburg, Va., near Washington. The new center, scheduled for completion in late 1962, will house 475 traffic controllers and maintenance technicians.

► **Federal Aviation Agency** has proposed a regulation requiring air carriers to measure slush on runways and adjust aircraft loads accordingly to ensure safe takeoffs. Under the proposal, airlines would revise takeoff data to account for retardation effects of slush, take their own measurements of depth and density of slush at several points, then determine safe takeoff weights.

► **Flying Tiger Line** has established Atlanta as the departure point for charter flights to Europe from the southeastern U. S.

► **Piedmont Airlines** has been awarded Capital Airlines' route between Norfolk and Knoxville by the Civil Aeronautics Board.

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Simplified Bio-Instrumentation Studied

By Barry Miller

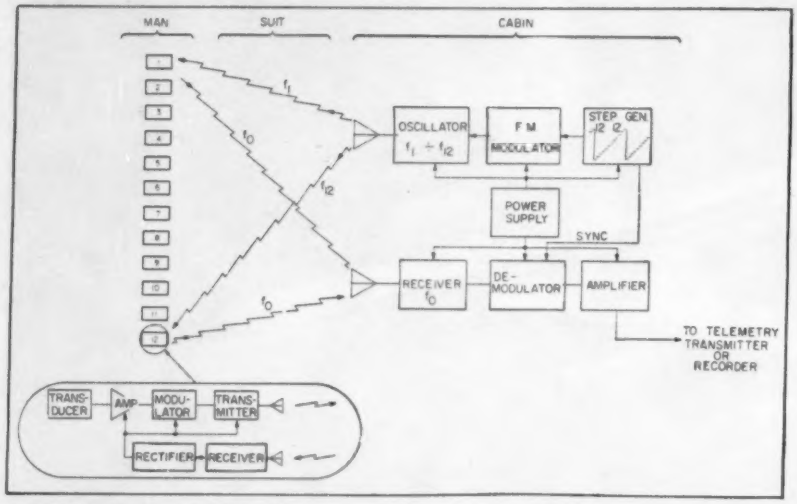
Los Angeles—Several designs of simple, lightweight instrument systems which could sample the physiological responses of an astronaut during flights of space vehicles in extreme environments without causing him much discomfort will be proposed by Lear, Inc., to several agencies in the next few months.

The proposed designs are aimed at cutting the weight and complexity of bio-astronautic instrument, or telemetry, systems and easing the restraints imposed on the pilot by the maze of wires now required for monitoring any number of his responses. With available equipment, obtaining biological data from a pilot in a full pressure suit is no simple task either for the pilot or observing physicians.

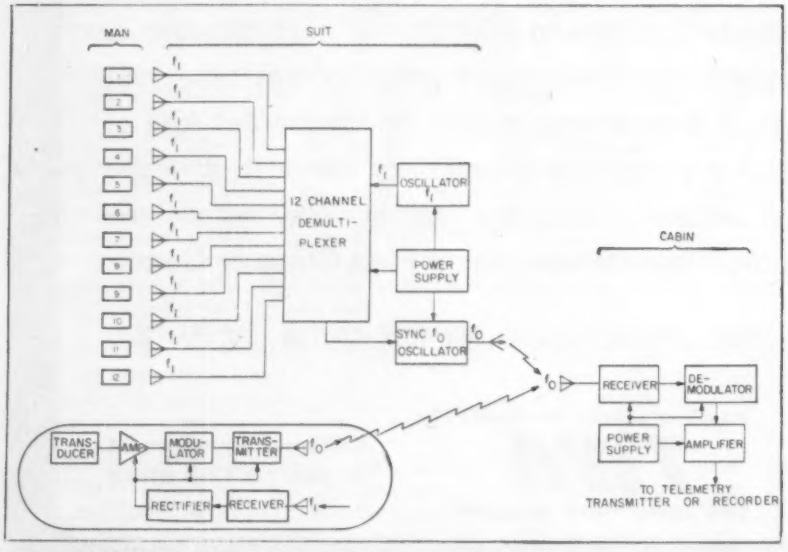
During flights of the North American X-15, for example, pilots are extensively wired. Leads run from wire-mesh electrodes jellied to different points on the pilot's body out through the pressure suit's umbilical cord to an instrument package in the cabin. There are, in all, four electrocardiogram leads plus several temperature-sensor leads. To monitor additional responses requires more leads, adds to the complexity of the system and probably to the pilot's discomfort.

Recognizing the need to simplify these measurements for X-15 flights the Air Force's Flight Test Center recently asked Hughes Aircraft to develop a microminiature signal conditioning package (AW Dec. 26, p. 71). Lear scientists hope that the bio-telemetry concepts they will suggest to military agencies and space contractors will be the basis of biological monitoring equipments for other manned space vehicles.

In its preferred design, the Lear approach would do away with wires and interconnecting cables which otherwise might inconvenience the pilot or hinder his movements. Because of the proposed reduction in system complexity, a sufficiently large number of information channels can be included to enable physicians to get many types of useful biological data from a pilot in space.



PROPOSED lightweight bio-astronautic instrumentation system (No. 1) for monitoring responses of pilots in pressure suits during flights of space vehicles would eliminate cumbersome interconnecting wires on pilot's body. Twelve microsensor packages (one of which appears as exploded block diagram at lower left), pasted to pilot's body, will employ microcircuitry, occupy a total of only 4.5 cu. in. Each sensor is sequentially interrogated on different frequencies by a step-generator-controlled oscillator in the vehicle's cabin. Alternating-current signals picked up by a coil in the microsensor receiver are rectified to supply d.c. power for the sensor's transmitter to return data signals to receiver in the cabin.



BIO-ASTRONAUTIC telemetry system No. 2, suggested by Lear, Inc., would place much of equipment on pilot's pressure suit. Power supplies could be located in soles of pilot's shoes with wires interconnecting power and circuitry contained within suit fabric.

Microcircuitry Techniques

Use of microcircuitry techniques developed by and about to go into pilot plant production at Lear's Solid-State Physics Laboratory here would slash the weight and add reliability and flexibility to the various avionic assemblies in the proposed instrumentation systems.

In each of the bio-astronautic systems suggested by Lear, small single-channel microsensors containing suitable electrodes or transducers capable of picking up the low-level human signals or converting physiological reactions to such signals would be taped to the pilot's body. The preferred design would be completely wireless. Its microsensor packages would transmit physiological data signals on command through the full pressure suit to a receiver located in a remote portion of the cabin. At that point, the signals can be recorded or retransmitted to ground receiving stations.

Power for each body-mounted microsensor package would be supplied by

electromagnetic induction of signals generated by an external transmitter. The absence of a power supply and the use of microcircuitry make it possible to squeeze equivalent sensor circuitry into a package even smaller than that of Douglas Aircraft's "Mini-sensors" (AW Dec. 19, p. 61). The Douglas unit contains sensor, amplifier and FM transmitter, designed with subminiature components, and employs a plug-in battery supply.

Each of three systems proposed by Lear would do away with the need for passing the data out through the umbilical cord of the pilot's suit.

Lear engineers prefer biological telemetry design No. 1 (shown on opposite page) in which only microsensors are attached to the pilot directly, major remaining portions of the system being located in the cabin. No wires, connectors or other gear are attached to the pressure suit and wires on the pilot's body are at a minimum.

Every body-mounted microsensor package includes a transducer for picking up physiological signals and a simple transmitter and command receiver. A power supply operating from batteries in the vehicle, a transmitting subsystem and a receiving subsystem comprise the equipment which would be located in the cabin.

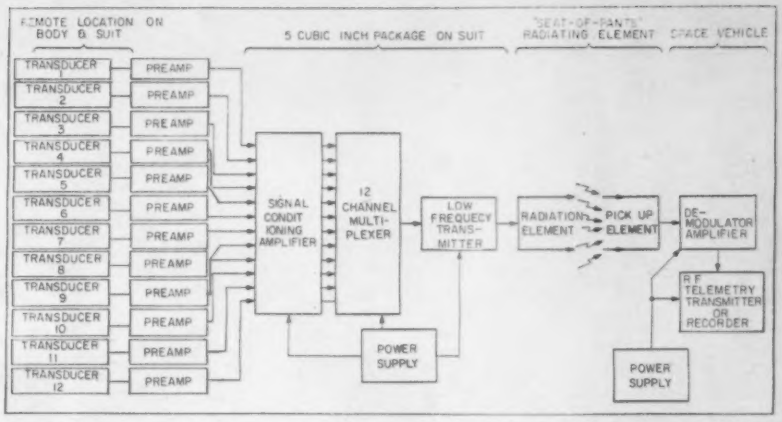
Cabin Transmitter

The cabin transmitter is an oscillator which operates sequentially over a series of fixed frequencies. A stairstep generator controls the oscillator's FM modulator so that output successfully switches from one frequency to another. Each of these frequencies, which might be 12 in number, designated F_1 through F_{12}, would be transmitted as commands to an equal number of microsensor packages on the pilot's body.

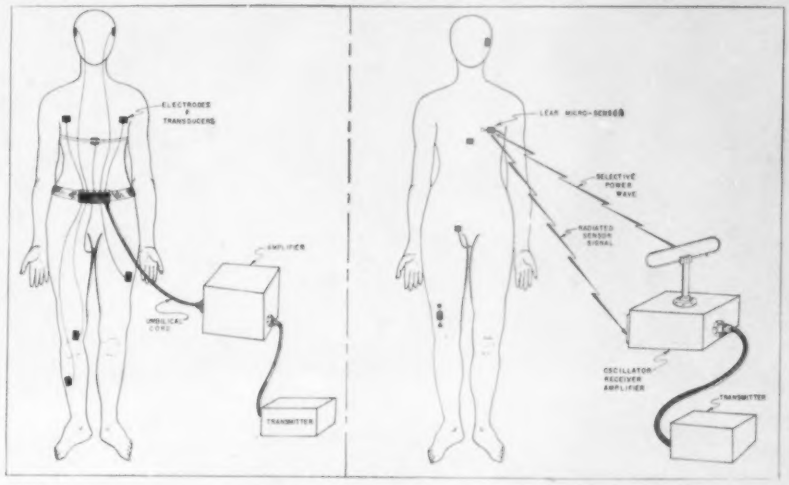
In turn, the cabin receiver picks up signals—all broadcast on the same frequency, F_6—from the 12 transmitters on the pilot's body. These 12 successive RF pulses are demodulated to amplitude samples proportional to those at the sensors and a sync pulse from the stairstep generator is added. The pulse train is finally amplified and applied to a recorder or to the vehicle's regular telemetry system for transmission to a ground station.

The FM/PAM signals transmitted in this fashion from the vehicle can be recorded on the ground or broken down into individual channel samples in a time-division demultiplexer. Time-division repetition rate is the rate at which "steps" are formed in the stairstep generator.

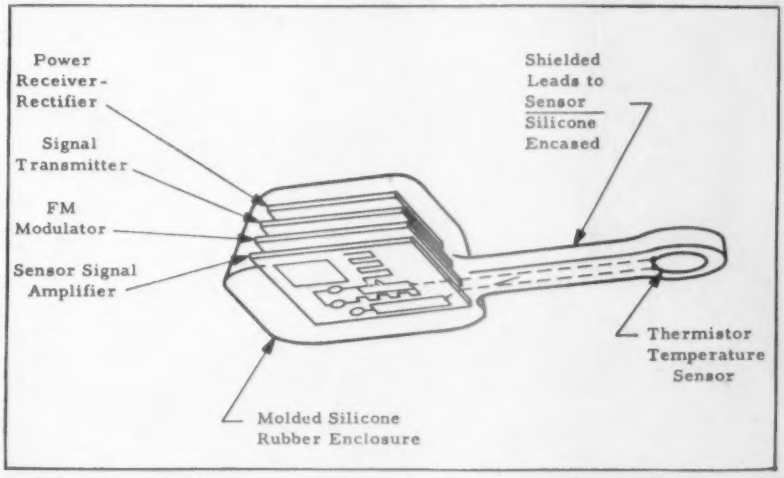
A typical microsensor would be completely encased in a molded silicone rubber enclosure. An arm or arms extending from the package would contain sensing elements such as a thermistor



THIRD bio-astronautic instrumentation system draws power for body instruments directly from suit battery rather than radiated energy. Interconnecting wires are required.



PHYSICAL layout of proposed bio-astronautic telemetry system (right), permitting physicians to obtain electrocardiograms, galvanic skin response, skin temperature and electroencephalograms during flights of space vehicles, is contrasted with current technique (left). New system would transmit physiological data through full pressure suit, eliminating reliance on umbilical cord, doing away with uncomfortable wires around body.



MICROSENSOR PACKAGE proposed for monitoring responses of space pilot in extreme environments would contain avionic microcircuits on four ¼-in. square subtrates as shown. Packages of this type, to be pasted on a pilot's skin, would be coated in molded silicone so as not to irritate skin or be damaged by body perspiration. Lear is nearing pilot plant production of microcircuits which would be suitable for sensor applications.

EXPANDING THE

Herodotus, the historian, records (490 B.C.) the use of burnished shields for military signaling. This was the forerunner of the heliograph, invented by Sir Henry C. Mance, which came into wide use centuries later.

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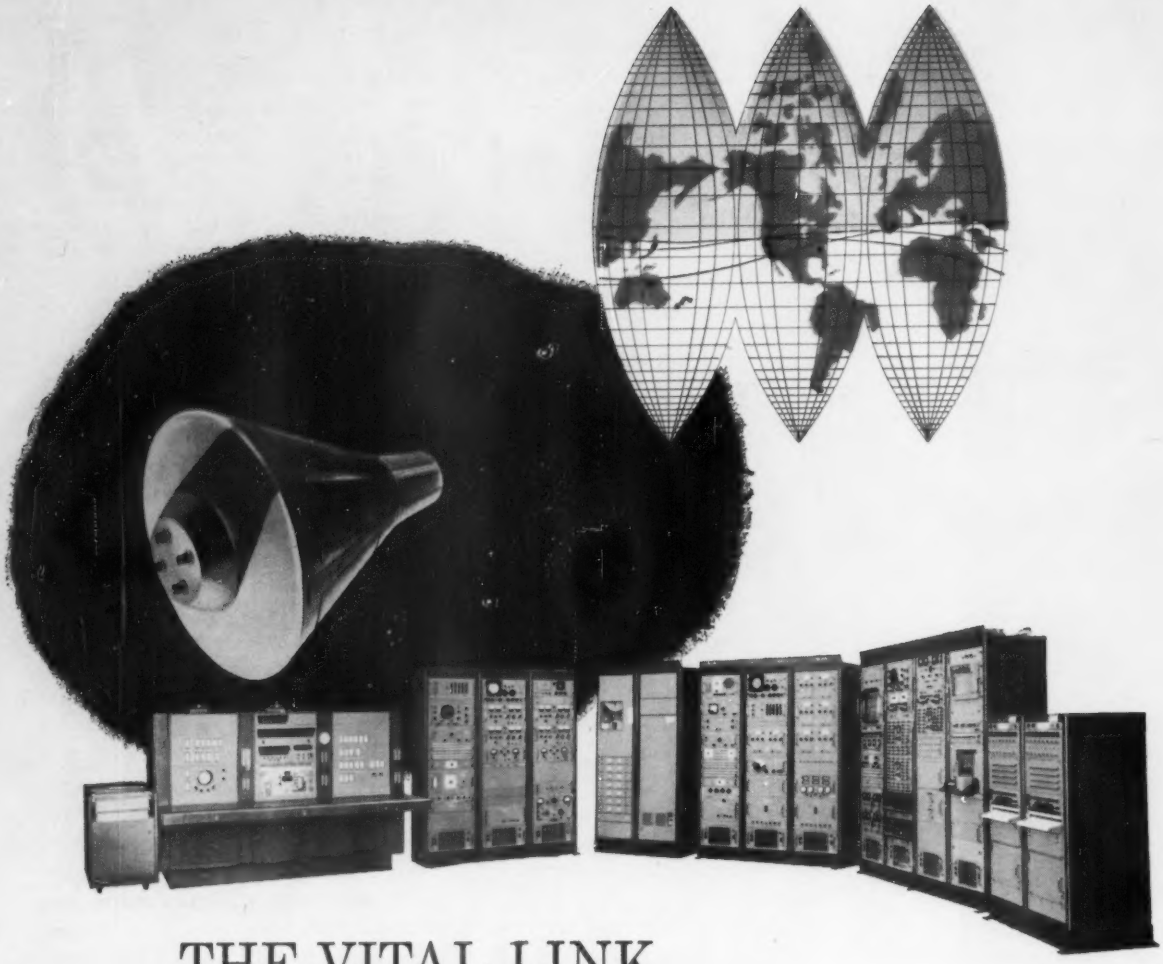

THE VITAL LINK WITH MAN IN ORBIT

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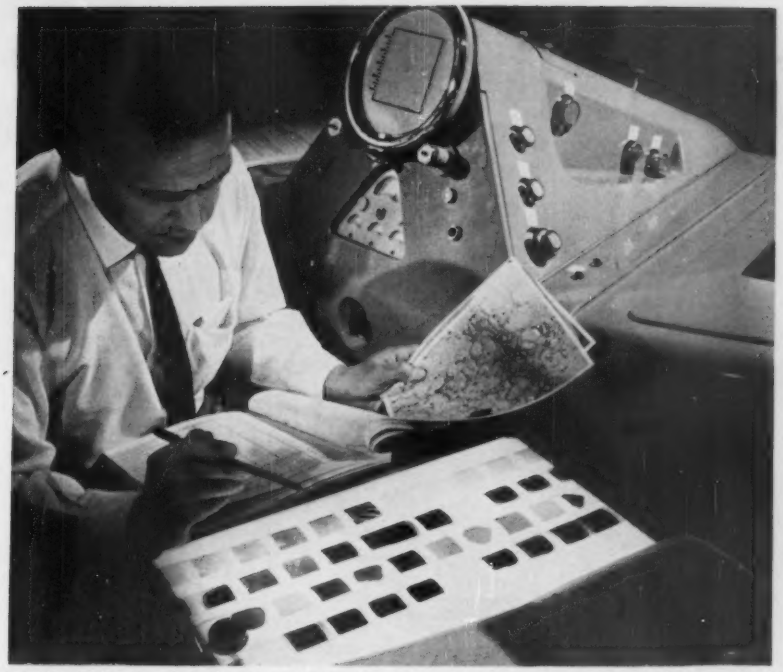

SCIENTIST at Lear's Solid-State Physics Laboratory checks surface and crystallinity of thin films with aid of electron microscope at his left.

for temperature sensing. The body of the package would house a stack of four microcircuits, accommodating the sensor signal amplifier, an FM modulator, signal transmitter and the power-receiver-rectifier, respectively. Microcircuits already fabricated by Lear for other applications indicate that such circuits, perhaps about ½ in. square and no more than 20 or 30 microns in thickness, are well within reach of circuit evaporation techniques used here.

Operation of system No. 1 would run as follows: Energy radiated from the cabin's transmitter on 12 successive frequencies is picked up and rectified on its appropriate frequency by a pickup coil in each sensor. The rectified signal provides d.c. power for the individual microsensor components. A limiter maintains constant d.c. level throughout any changes in RF coupling.

Once d.c. power is made available, an amplifier boosts signals fed to it by a transducer or sensing element which picks up variations in physiological functions as changes in voltage, current or resistance. Amplified signals are passed to a modulator which frequency modulates the microsensor's small transmitter operating at F_0. Tuning of the pickup coil in each microsensor receiver determines which microsensor will be energized by one of the 12 transmitted frequencies, F_1 to F_{12}. Hence, power is received at one frequency, transformed to d.c. and radiated back to the cabin receiver on a frequency common for all 12 microsensor transmitters.

Advantages of design No. 1, according to Lear scientists, are:

- **Minimum noise pickup** in the absence of connecting wires.
- **No trailing wires** connecting the pilot to the suit.
- **Electric shock threat** is eliminated with the absence of wires between the suit and the vehicle.
- **Pilot is made less uncomfortable** with the absence of wires needed for monitoring.
- **Microcircuitry eliminates** potentially unreliable connections between components and reduces size and complexity of the package. Total volume required by the sensors (located on the body, suit and helmet) for monitoring 12 channels would be about 4.5 cu. in., Lear scientists say.
- **No connectors** are necessary because no wires are needed.
- **Indefinite life** may be possible without the presence of batteries in the microsensors. The vehicle supplies all power.
- **Cabin equipment** can be checked at any time with a simulator instead of requiring that a man don the equipment and the pressure suit.

Assuring adequate power transfer into the microsensors may pose a serious problem, Lear scientists concede. If the pilot is to be strapped to a seat throughout his flight, tight coupling could be obtained by installing several large coupling coils in the seat itself. If he is to move about, multiple coils or other types of radiators scattered about the interior of the cabin can provide a relatively constant field on all

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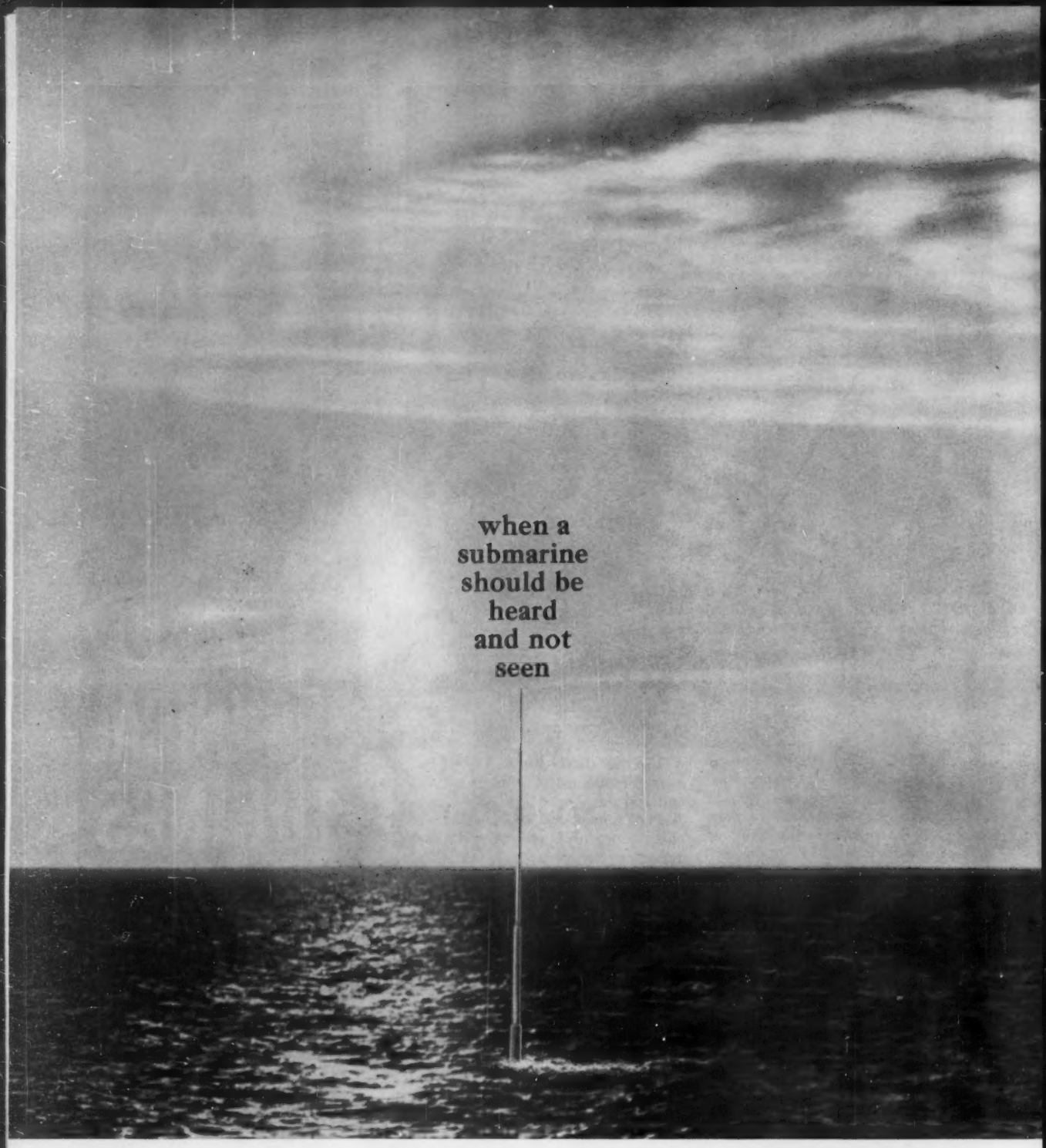

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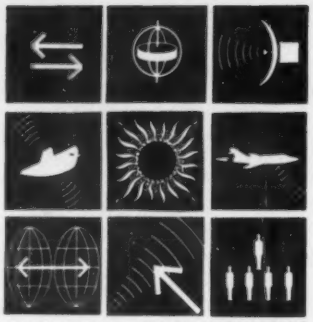

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sides, the scientists reason. Once minimum coupling in any position is known, however, a limiting level can be set in the microsensor so that sufficient constant d.c. power is available for minimum coupling.

Another concern with this approach is the need to ensure that the sensor receivers are sufficiently selective so that they are not turned on indiscriminately by the wrong command frequency. This might be satisfied by setting a lower d.c. voltage limit below which microsensor power, unintentionally available at the incorrect receiver, is not applied to the components.

Effects of variable coupling from the microsensor back to the cabin receiver will be minimized by FM and receiver limiter design. Receiver discriminator output will then be a series of amplitude-modulated pulses reflecting sensor conditions yet unaffected by amplitude variations due to coupling.

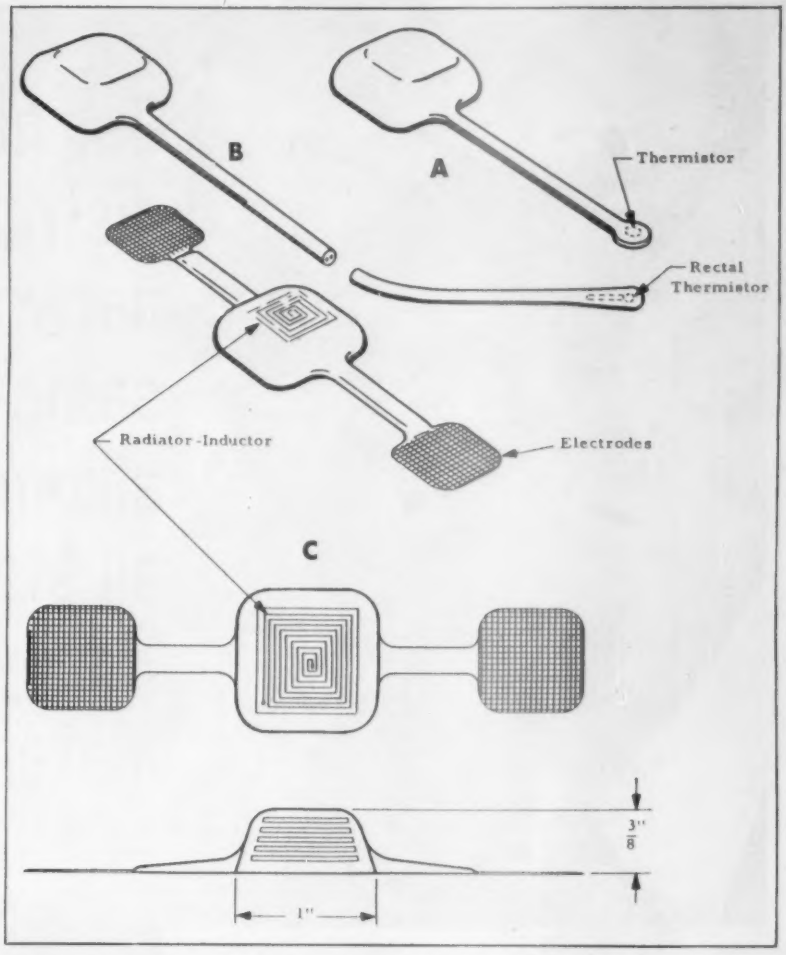
High frequency response of the sensors can be accommodated by setting clock rate (stairstep generator rate) at a suitably high value. A sync pulse set at a higher level than any data pulse and added during each sampling frame provides synchronization. The receiving demultiplexer could use a flywheel sync circuit similar to that of a television receiver.

Proper choice of operating frequencies should lessen any chance that spurious radiation from other sources in the vehicle might energize the microsensors or that sensor signals might interfere with other avionic equipment.

Two other bio-astronautic telemetry systems are suggested by Lear should the first fail to prove as attractive as the company believes it appears. System No. 2 (shown bottom of p. 52) differs from system No. 1, in that:

- **Much of the equipment** previously located in the cabin is now shifted to the suit.
- **Signal power distribution** method is changed.

OPERATIONAL microcircuits made at Lear with these 5-mil thick stainless steel masks contain evaporated passive circuitry and uncased transistors. Similar microcircuits are proposed for use in biological sensors.



CONFIGURATION of body-mounted microsensor may vary as a function of the physiological data required. Possible microsensors could contain thermistor for skin temperature (a), rectal thermistor for body temperature (b), and electrodes for electrocardiogram (c).

In system No. 2, 12 microsensors such as the ones proposed for the first system are again attached to the pilot, his suit and his helmet. Small induction coils, located in his suit at points close to the microsensors, are energized on a single fixed frequency by an oscillator, also situated on the suit. A time-division demultiplexer sequences the oscillator power into the appropriate coils so that power is supplied to each microsensor in sequence.

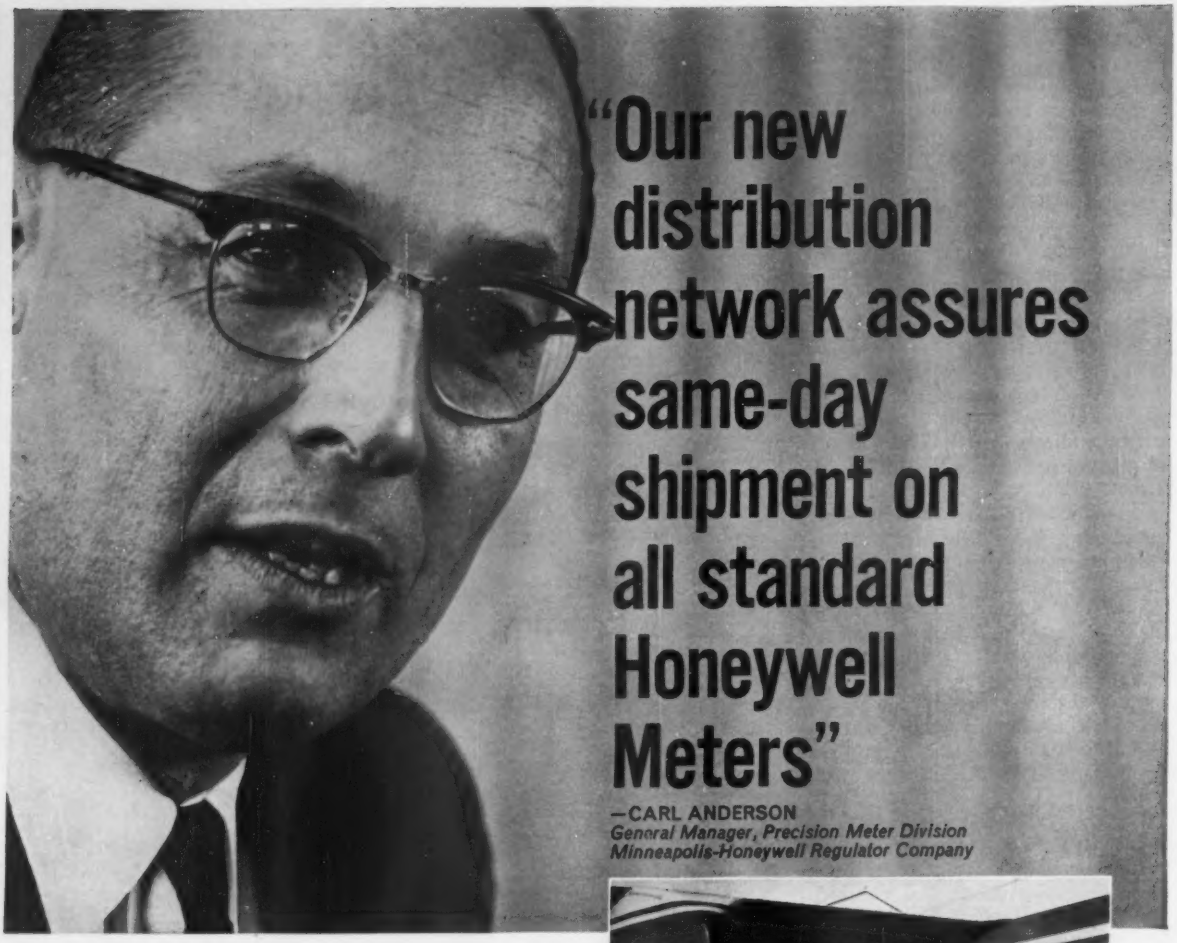
As in system No. 1, each microsensor transmits on the same fixed frequency F_o. A sync pulse generated in the demultiplexer is transmitted to the cabin receiver at the start of each sampling frame. The train of RF pulses from the microsensors and the sync pulse are picked up by the cabin receiver and demodulated to a train of d.c. pulses to frequency-modulate the vehicle's regular telemetry transmitter.

Mercury cells wired to the avionic gear on the suit provide necessary power. To save more space, the cells could substitute for dead weight in the soles of the pilot's shoes. Circuits would be housed in one or two packages attached at or to the suit belt. The power oscillator and sync transmitter, both located on the suit, are expected to be simple and small as neither need be powerful (favoring microminiaturization techniques) when located close to adjacent coils.

Demultiplexer Available

A demultiplexer which could do the job is available, made with standard components, and need only be microminiaturized. Present units are built on a per channel basis with each channel packaged in a ½-in. cube built with off-the-shelf components.

System No. 2 has many of system No. 1's advantages plus better power transfer because of close coupling. This permits use of a lower power transmitter and results in less power drain on the batteries. The suit transmitter is less susceptible to drift because it is fix-tuned. Close coupling permits limiters in the microsensor power supplies



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to be set at higher levels, thereby wasting less power on strong signals.

For this system d.c. power might be supplied partially by a mercury cell in each microsensor with the time-shared signal used only as a trigger or control. This would scatter batteries over the pilot's body but would require less overall power.

Additional points which characterize system No. 2 are:

- **Pilot must wear** pressure suit during checkout of microsensors and suit equipment.
- **Equipment is attached to,** and wires are contained within, the suit.
- **Mutual interference** is minimized by using only two, rather than 13, frequencies as in system No. 1.
- **Supply of power** to the microsensors is partially satisfied by close coupling which should cut the microsensor d.c. power needs.

A third more conservative approach to instrumenting man in space suggested by Lear scientists (see diagram on p. 53) is somewhat similar to conventional telemetry. Each individual transducer or sensor has its own preamplifier whose output feeds a composite signal-conditioning amplifier, then a multiplexer. The 12 signals are multiplexed onto a single channel and used to modulate a low-frequency transmitter. The signal conditioning amplifier, multiplexer and transmitter can all be shrunk into a 5-cu.-in. microcircuit package on the suit.

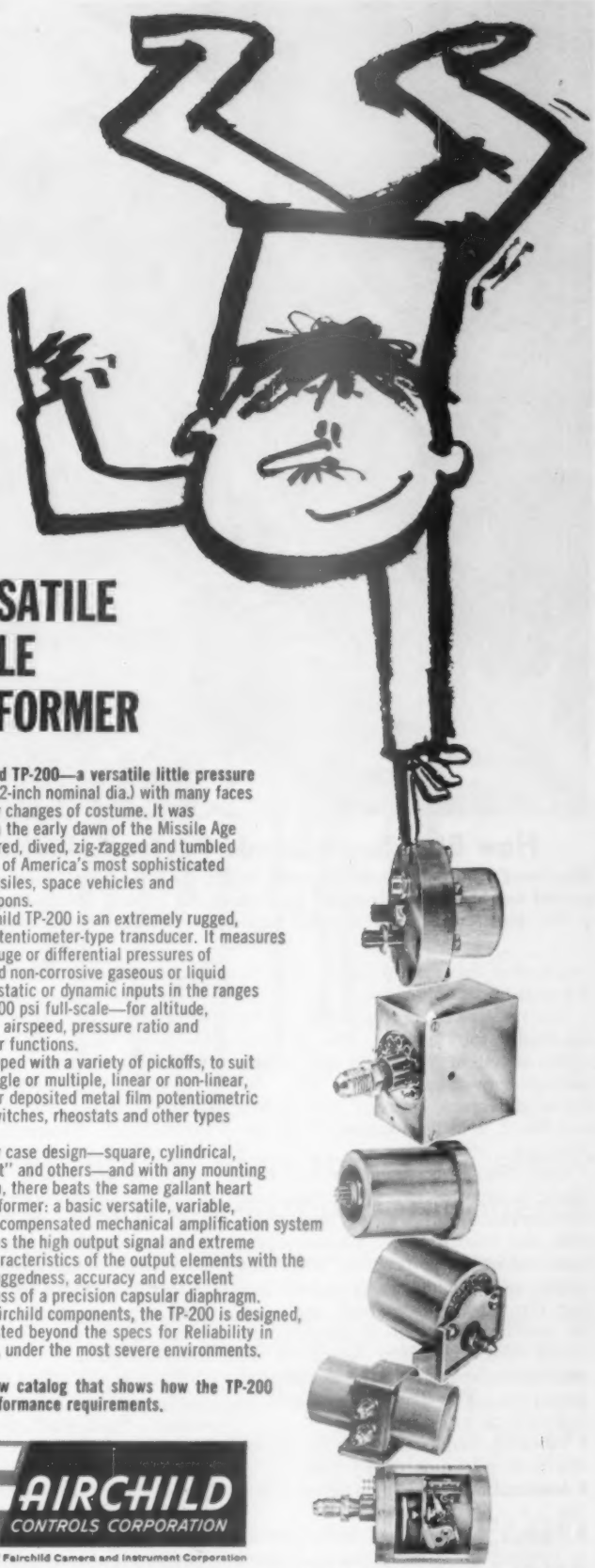
Power supply for the suit equipment might again be buried in the pilot's shoe.

The low-frequency suit transmitter feeds an induction coil within the suit as in system No. 2. Signals are received by a pickup coil, fed to a low-frequency receiver, demodulated and passed to the regular telemetry transmitter. The cabin portion of the system is identical to that of system No. 2.

System Characteristics

This system differs from a conventional one and the two others outlined by Lear scientists in that:

- **Power and signal wires** between man and suit, which systems No. 1 and No. 2 were designed to eliminate, are reintroduced. This adds to the discomfort of the pilot and makes getting in and out of the suit more difficult.
- **Power for the microsensors** is supplied directly by the suit battery rather than by radiated energy or the umbilical cord. This assures proper d.c. voltages at all times and reduces the amount of equipment in the microsensors. Preamp and signal conditioning functions may be combined by properly adjusting gains and low-pass filter characteristics.
- **Reduction in noise** by preamplifying at critical sensors and elimination of umbilical cord would be the chief ad-



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How Blue Scout Sheds Payload Heat Shields

Blue Scout I three-stage solid-propellant rocket, shown in artist's conception shedding its payload heat shields, was launched Jan. 7 down the Atlantic Missile Range (AW Jan. 16, p. 35). Blue Scout I was first guided version to be launched by Air Force.

vantages of this system compared with a conventional approach.

The multiplexer of this system can be essentially the same as the demultiplexer of system No. 2 with only input/output connections altered. This, the major difference between this system and No. 2, is in the location of the amplifiers.

Any bio-astronautic microsensors would be expected to resist various space environments and still be compatible with the human body. Consequently, Lear scientists propose to cover the sensor with silicone rubber to both protect the package from body acids and perspiration and to avoid irritating the pilot's skin. An added benefit of the silicone enclosure is its good dielectric properties. The same design will be expected to withstand:

- **Vibration frequencies** from five to 500 cps. with g loading up to 15g.
- **Acceleration loads** ranging from −3 to 20g.
- **Pressure environments** from vacuum to beyond one atmosphere as a guard against failure in the pressurization system and excessive pressures produced by ram effects in the atmosphere.

The microsensors would be capable of sensing and transmitting data for the following:

- **Electrocardiogram** – Voltages from zero to 120 microvolts would be picked up by electrodes attached at three points on the body. Measuring such low voltages against a reference would be simplified by shorter lead lengths and "on-the-man" amplification embodied in its approaches, Lear says.
- **Electroencephalogram**—Sleep and approaching unconsciousness, perhaps one of the more vexing conditions the astronaut may face, can be detected by measuring "brain waves" with the electroencephalogram.

These signals could initiate automatic warning of the pilot or action by observers. Brain wave signal levels range from five to 200 microvolts.

- **Phonocardiogram**—Mechanical vibrations of the chest wall produced by the heart can be detected by microsensors, much as a physician's stethoscope would do. Besides being an EKG backup, the phonocardiogram can also be a form of secondary voice channel from the astronaut because vocal sounds are inadvertently detected.
- **Body temperature**—Skin and body temperatures can be sensed by high resistance temperature coefficient thermistors which provide stable signals when calibrated. Available thermistor shapes can be used as rectal and skin transducers. Even tiny elements introduced painlessly under the skin with special hollow needles might be incorporated in this microsensor approach.
- **Galvanic skin response**—An integral sensor-electrode device could pick up changes in skin resistance produced by varying mental stresses on the pilot.
- **Sound**—A microsensor, perhaps using a piezoelectric pickup, located near the inlet to the ear canal could measure decibel level of noise.
- **Other parameters**—Pressures associated with suit and helmet and breathing functions can be detected with appropriate transducers involving changes in electrical resistance.

An integral part of Lear's bio-astronautic instrumentation plans is the microcircuitry work of its Solid-State Physics Laboratory. Lear's microcircuitry approach which developed rapidly from research to pilot plant production in the past year involves evaporation of passive films on glass substrates (AW Dec. 12, p. 105). Uncased transistors are either cemented to the substrate or inserted into holes ultrasonically drilled through the subtrate.

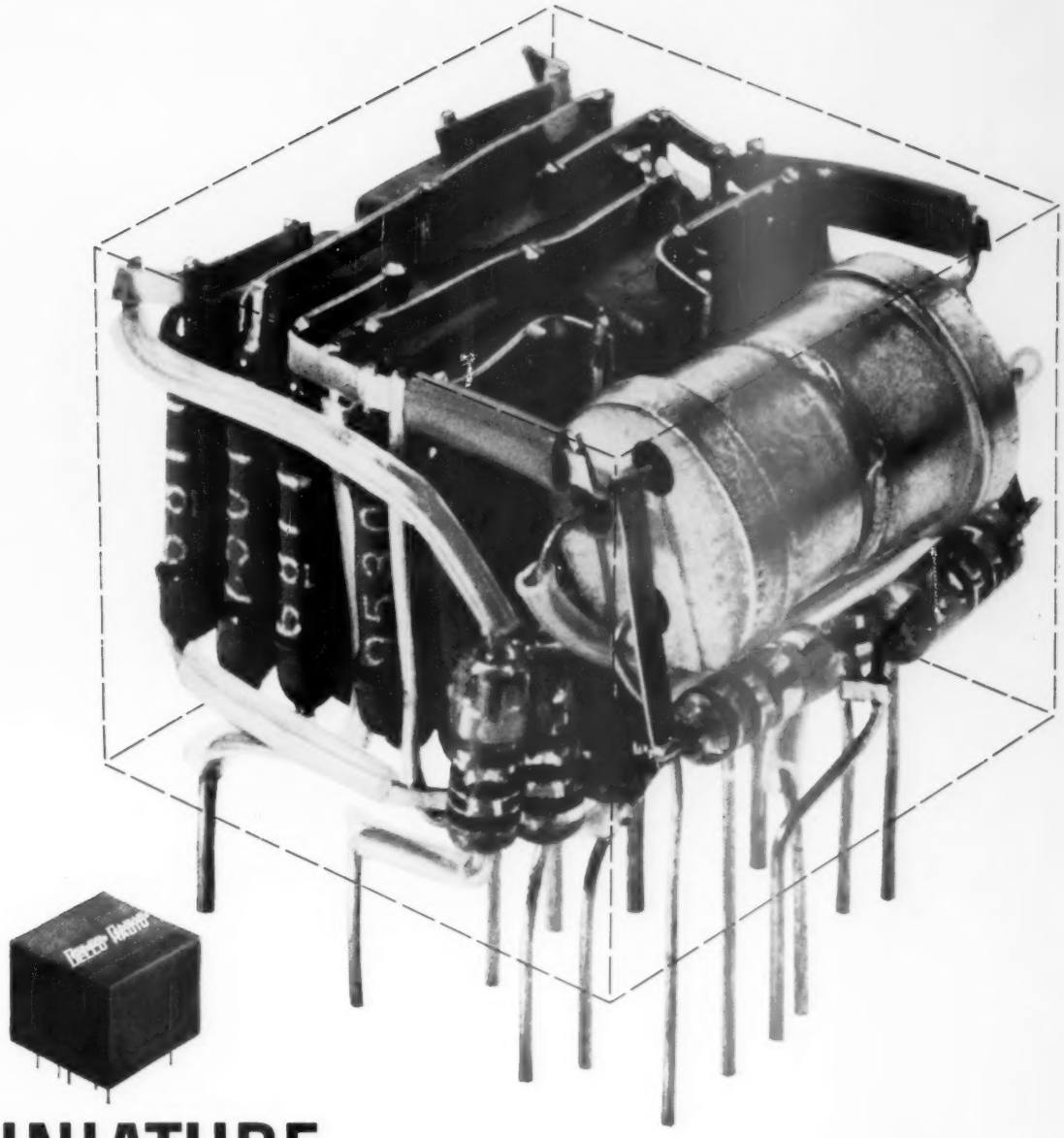
Lear is researching a technique for evaporating single crystal semiconductors on a special single-crystal dielectric whose crystal structure matches that of the semiconductor. Success with this work would enable both active and passive components to be synthesized by evaporation on a single substrate.

Resistive elements are being evaporated in 100 ohms/square values over a 5% spread around the nominal value for groups of eight resistors (without tailoring). A single resistor can be prepared to within 2%, Lear scientists say. Capacitors are being deposited in values up to 2,000 picofarads. Film thickness runs about 1,500 angstroms, minimum line width for any film is about 5 mils.

In one test to check stability of films, exposed resistors were measured after 30 days of storage. Maximum change for any resistor in a group of 24 from a single run was 0.07%, according to Richard Radke, senior physicist responsible for the evaporation work.

The Solid-State group is using nichrome for resistors, aluminum for conductors and a sandwich of silicon and silicon monoxide as the dielectric for capacitors. Top working capacitor value is 0.08 mfd. per sq. in., Radke says.

Films are evaporated through masks onto a substrate in bell jars at pressures of 2×10^{-6} mm. of mercury. Val-



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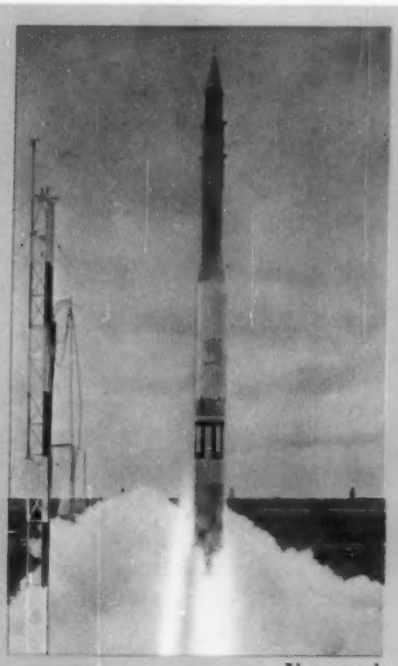
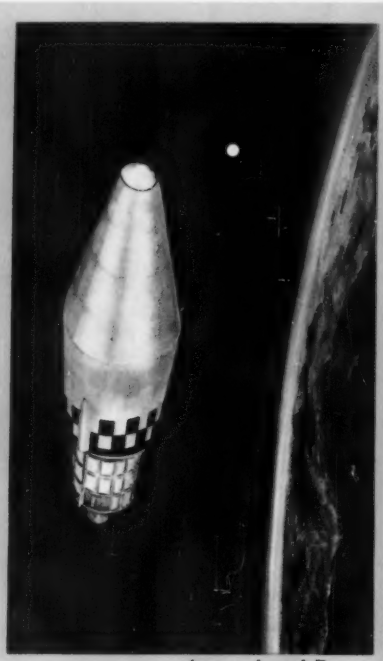


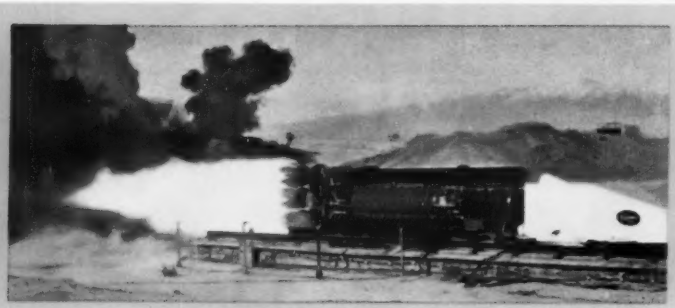
Vanguard

Nike Ajax

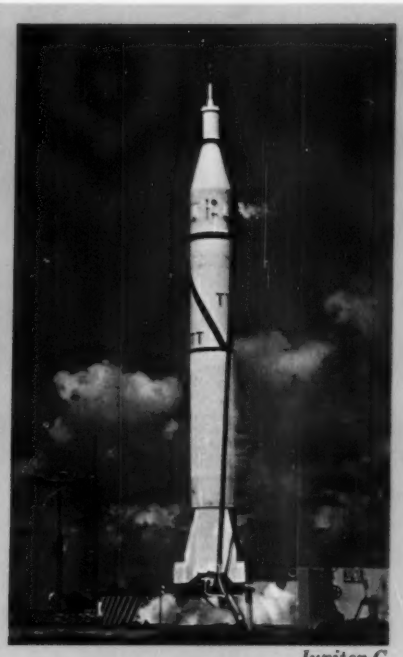


Agena A and B

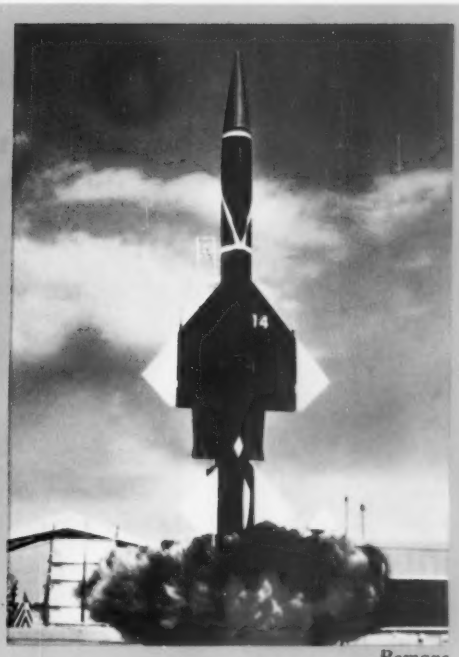
LAR



Rocket Sled



Jupiter-C



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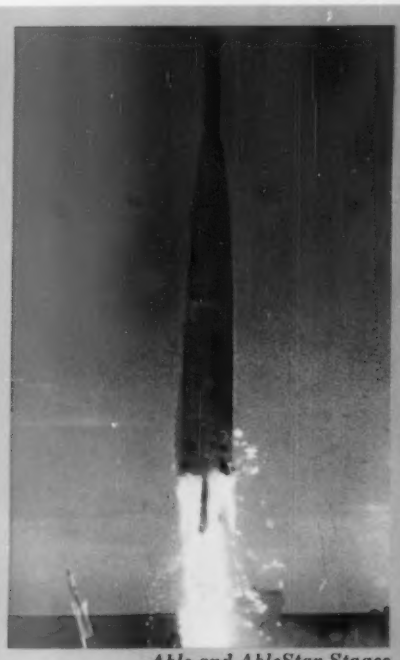

Able and AbleStar Stages

Rascal

Bullpup

Experimental Manned Aircraft (X-IE)

Sparrow III

Photos: Courtesy U.S. Army, U.S. Air Force, NOTS, Bell Aircraft Co., Boeing Airplane Co., Coleman Engineering, Douglas Aircraft Co., Inc., Lockheed Aircraft Corp., Martin Co., Thiokol/Reaction Motors

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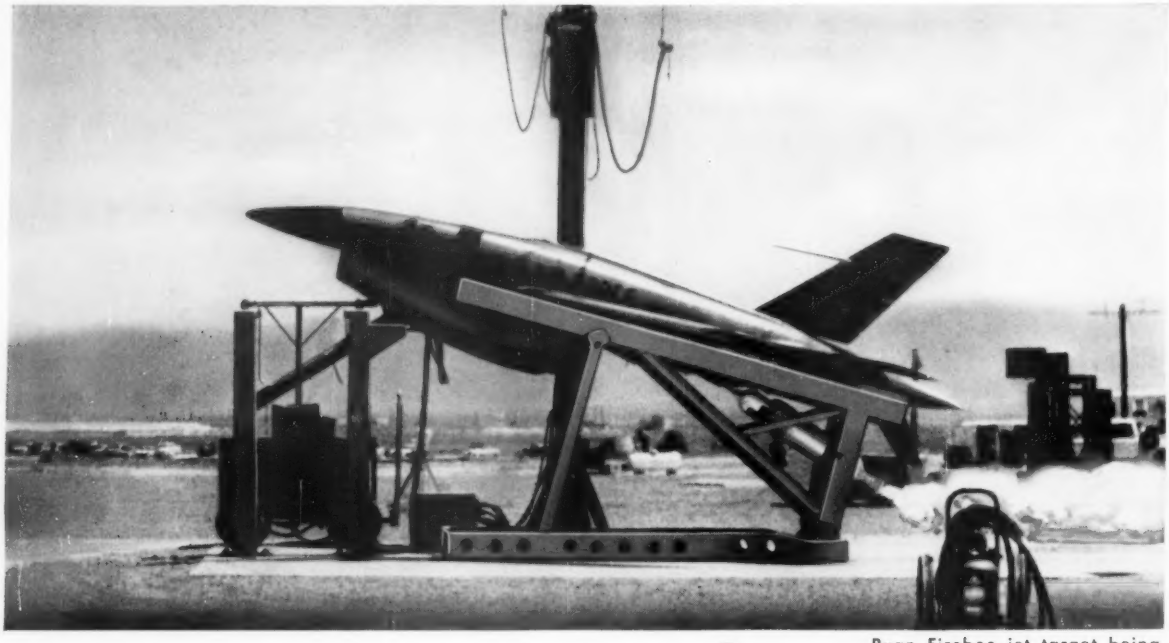

Ryan Firebee jet target being launched from a Fruehauf launcher

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ues of components are monitored from conveniently located monitoring strips prepared in the mask and situated alongside the circuit.

Success of thin film evaporation frequently hinges on the precision with which masks are prepared and how they are made. Too often, according to Lear scientists, masks for film resistors which commonly are made in crenelated patterns tend to bend at the edges, thereby ruining the mask. To avoid this problem, the Solid-State Laboratory deposits resistive films in parallel lines, then connects their ends in a subsequent evaporative process by depositing parallel connecting conductors at right angles to the resistive elements.

Extensive effort is devoted to preparation of quality stainless steel masks to assure fine control of film patterns. The masks are prepared as follows, explains Robert Roth, who heads the methods department:

Layouts of the film circuit configurations are prepared on paper—typically 25 times final desired microcircuit size. Each type of element—resistor, conductor, electrode and counter electrode are colored differently. Then, a sequence of double-layered transparent plastic sheets (the top in red, the bottom clear) are placed over the circuit. The pattern for one type of element is traced and cut from the top colored layer of the sheet, leaving a clear pattern of one element type on the sheet. This is repeated for each element on separate sheets.

A counter etched pattern (for selective etching of the back side of the mask) and a frame pattern with a suitable monitoring line in the same 25 times actual size, one for each element, are prepared also. In making a film resistor network, for example, these patterns are individually photo reduced to five times actual size. A composite is made by matching the resistor pattern with a frame and separately the counter etched side of the resistor pattern with another frame.

These are photo reduced again to actual size, the front and back sides aligned and sandwiched about a 5-mil sheet of stainless steel covered with photoresist. The film is then exposed and the stock etched on either side. The conductor pattern for the resistor network is similarly prepared.

Silver tabs are screened around the periphery of the final substrate. Every component on the substrate is terminated in two tabs, Roth says, so that any components can be probed.

For tailoring precision resistors, two small parallel resistors are evaporated in series with the nominal component and are shorted or put into series to tailor the resistor to its exact desired value.

The entire technology of bio-astronautic instrumentation is regarded by many observers to be lagging other technical developments required for manned space flight. Consequently the designs proposed by Lear's Astronics Division and Solid-State Laboratory might well be the basis of future biological monitoring equipment. Physiological studies in connection with this work will be handled by the Lovelace Foundation in Albuquerque, N. M.

Thor Stands Adapted For Saturn S-IV Tests

Santa Monica, Calif.—Douglas Aircraft Co. has begun a $2-million program to convert old Thor IRBM test stands at the company's Sacramento field station for static testing of the S-IV stage of National Aeronautics and Space Administration's Saturn space vehicle booster.

The S-IV, being developed by Douglas for NASA's George C. Marshall Space Flight Center, is to be the second stage in the C-1 version of Saturn and is slated to be the third stage of the C-2 vehicle if it is built.

Modifications to the Sacramento test site include installation of a liquid hydrogen storage and transfer system and the enlargement of two of the test stands for cold-flow testing and static firing of the S-IV. Cold flow or propellant transfer tests will be the first to be conducted in the modified facilities using a "battleship" version of the S-IV to simulate the physical characteristics of the actual vehicle.

By late 1962, four Pratt & Whitney LR-119 liquid hydrogen-liquid oxygen engines are scheduled to be mounted in the battleship structure to test the S-IV propulsion system. Each LR-119 engine produces 17,500 lb. thrust. Later, one of the two converted test stands will be used for acceptance testing of production S-IV stages and the other will be used for continued development tests using a production airframe.

Steam ejector pumps will be used to create a vacuum around the engine nozzles in ignition tests to simulate the high altitude at which actual S-IV stages will be started.

Other projects in the Sacramento field station conversion program include installation of two 90,000-gal., 35-ft. dia. spherical liquid hydrogen tanks, construction of a steam plant to power the altitude simulators, and installation of a 14,000-gal. liquid oxygen tank.

Douglas has let contracts to Aetron Division of Aerojet-General for design and engineering of the conversion, to Consolidated Western Steel for preliminary modification of one test stand, to Southwest Welding and Manufacturing to build the battleship airframe and to Chicago Bridge and Iron to design and build liquid hydrogen tanks.

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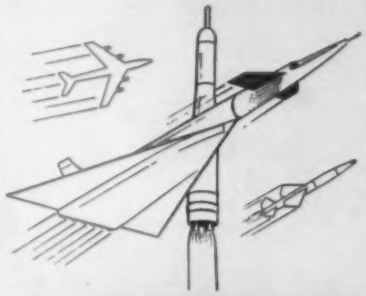

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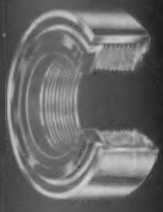

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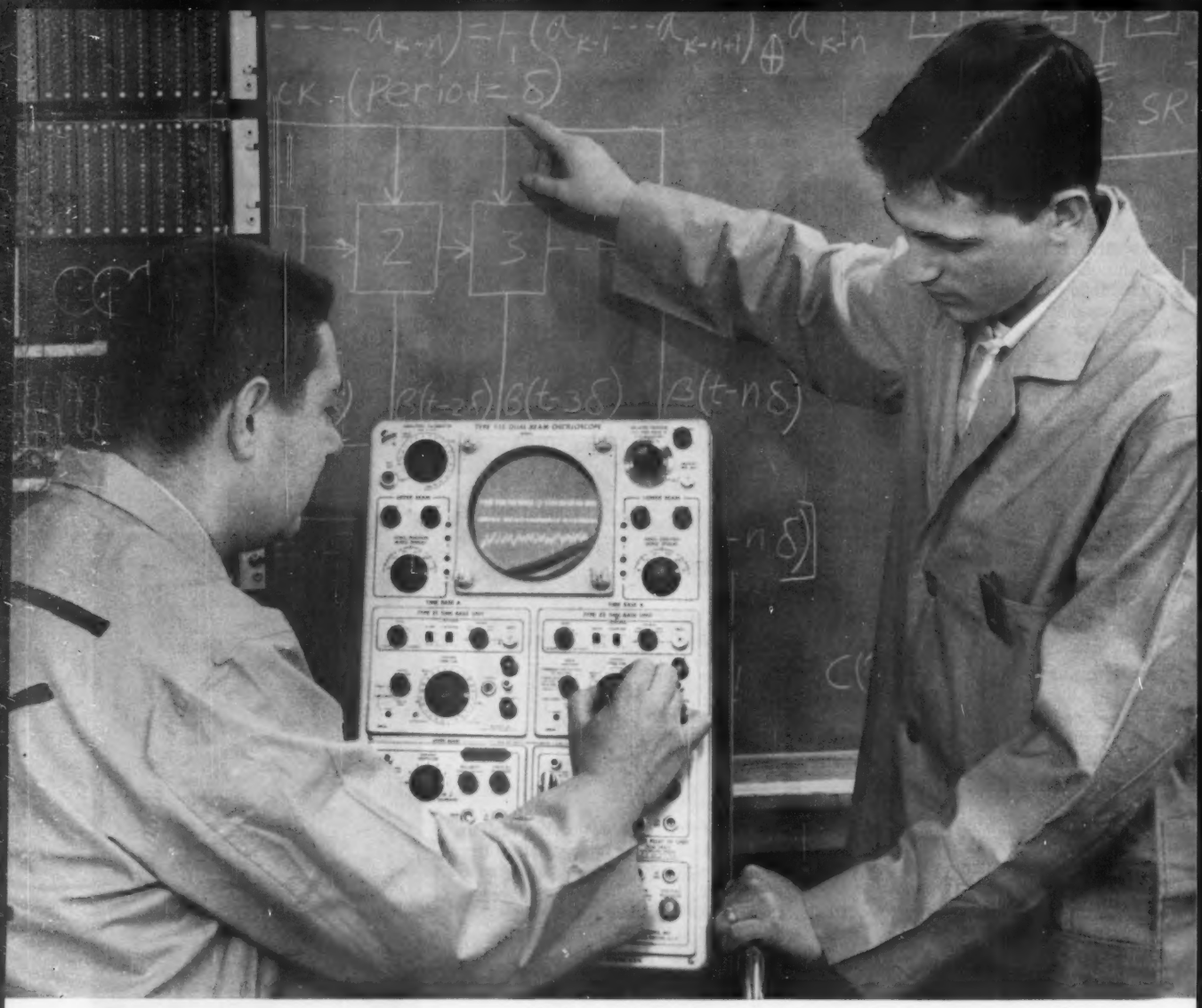

Results of analysis and experiments on pseudo-random sequence generators are correlated to determine optimum sequences for anti-jam communications systems.

TAKING THE JAM OUT OF JAMMING Using pseudo-random noise techniques, Bendix engineers have designed advanced aerospace communications systems that are resistant to all types of jammers. A combined experimental, analytical, and developmental effort has resulted in new anti-jam techniques for both voice and digital data. Automatic synchronization offers a high degree of operational convenience for communication with moving aircraft or space vehicles. Inquiries for career opportunities are invited from better scientists and engineers.

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Mercury Capsule Testbed Role Proposed

Langley Field, Va.—Capsules developed for the Mercury manned spaceflight project may become the basic craft in a long-lived flight-testing program for components and techniques to develop advanced manned space vehicles.

Robert R. Gilruth, director of the National Aeronautics and Space Administration's Space Task Group, believes the Mercury capsule can be modified for development of landing guidance systems, probably by adding tabs or flaps to provide enough lift for controlled re-entry and landing.

Return and landing guidance research can be applied to military capsules such as Samos, as well as to the manned Dyna-Soar and Apollo.

Although Mercury is a frontier type program whose critics consider it of marginal value for manned space exploration, there have been no outspoken critics of the capsule engineering design. Gilruth feels many features of both the capsule and the program will carry over to advanced manned spaceflight programs. Among these are:

- **Technical management** and industrial know-how generated by the Mercury history of pushing rapidly into a new realm of flight.
- **Emergency capability** for rescuing a pilot during an abort on or during early flight.
- **Emergency capability** for rescuing a pilot during an abort on the pad or during early flight.
- **Worldwide tracking network** that can collect and display data on vehicle and occupant instantaneously.
- **Medical and life sciences** information, expected to be developed in the area of extended weightless flight with first knowledge of the ability of a pilot to perform in a zero gravity.
- **Flight maneuvers** such as in-flight control, retrorocket ignition, re-entry.

Continued use of the Mercury envelope to develop structures and components for advanced systems such as Apollo and manned lunar landing vehicles probably would mean extension of the capsule contract with McDonnell Aircraft Corp. The production contract now is scheduled to end with delivery of 24 vehicles.

The original approach to Mercury was to develop the capsule as the simplest vehicle able to perform manned orbital missions and be recovered. Charles J. Donlan, associate STG director for development, says the approach has not changed, but distinct research programs were required in some unexpected areas.

Capsule shape was fixed after 5,000 hr. of wind tunnel testing of 70 model configurations. Other research programs were required in systems miniaturization to meet the Atlas booster weight limit, in structures, heat shielding, parachute recovery, attitude, controls, escape system, mission sequencing, pilot couch, shingle design, retrograde, posigrade and escape rockets, and in adapting the booster to carry the capsule (AW Jan. 16, p. 27).

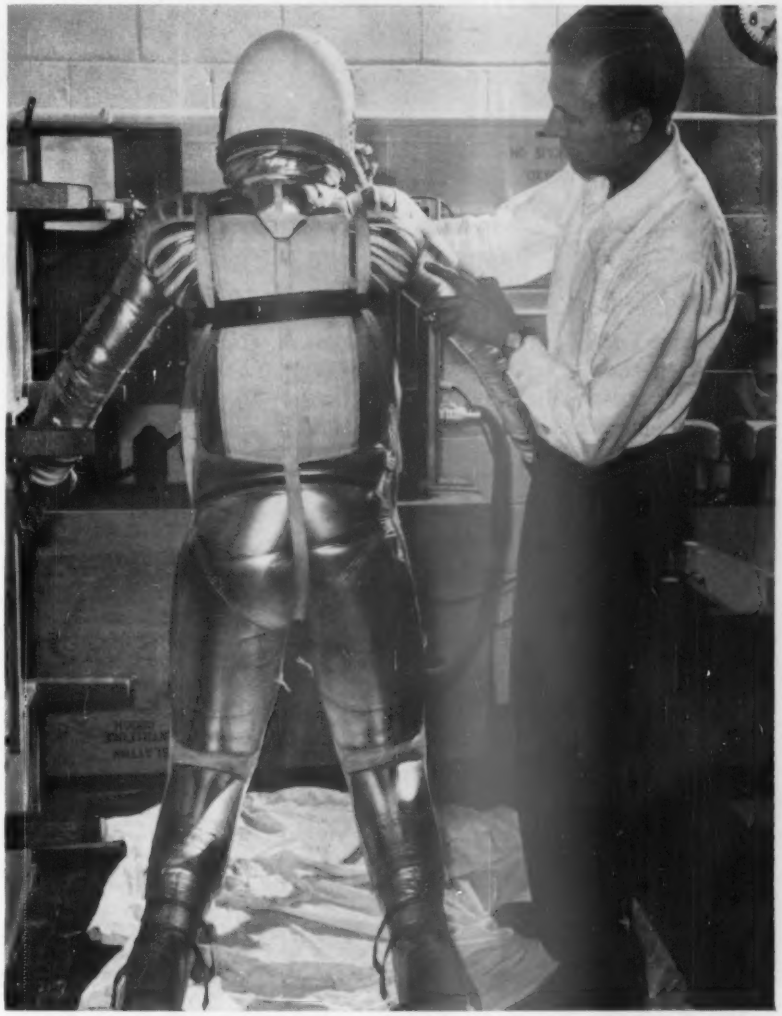
As the Mercury program moved to the flight phase, these operations problems developed:

- **Training,** which had to be planned to combine the experience of missile and airplane specialists.
- **Atlantic Missile Range** procedure, which had to be modified from weapons tests and spacecraft launches to include a pilot.
- **New facilities,** which were required at the Atlantic Missile Range and to establish the worldwide tracking net.

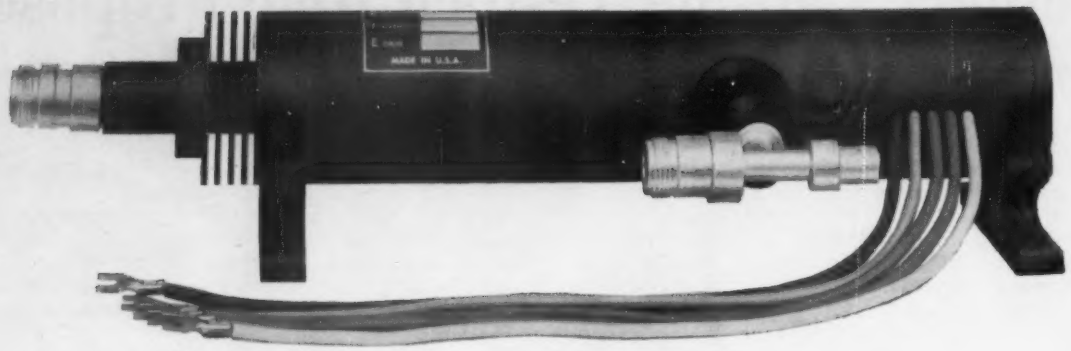
Walter C. Williams, associate STG director for operations, said an eight-part program has been developed to prepare the capsule for launch countdown. The program begins with capsule receipt at the Mercury hangar, where it is inspected, given a preliminary systems check and a simulated flight test.

It then is taken to the pad for compatibility mating, flight acceptance and static firing.

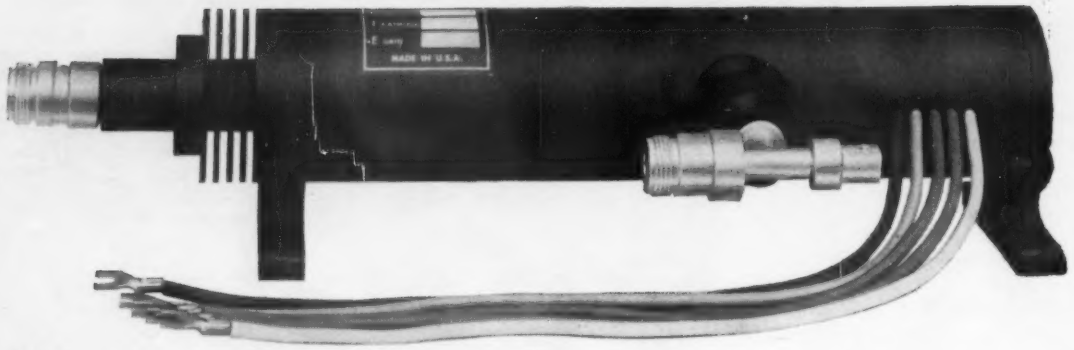
The capsule is returned to the hangar and made flight ready. Pyrotechnics and flight parachutes are installed when the capsule is replaced on the booster ready for launch.



SUIT to be worn by Project Mercury astronauts is coated with a silver spray which acts as a heat buffer and radiation shield. Under normal space conditions the suit would remain unpressurized; however, in the event of cabin pressure failure the suit would be quickly inflated, as shown, to provide a gaseous environment of 5 psi.



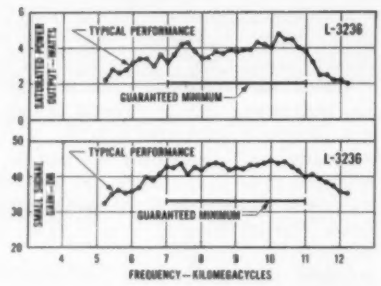
TWTwins

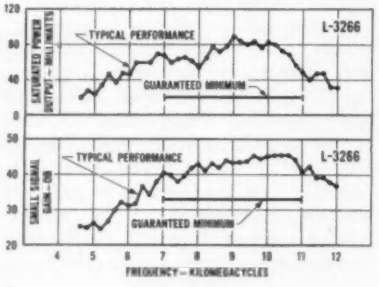


These Litton TWT twins are PPM focussed X-band traveling wave tubes. They are *not* prototypes. They are metal and ceramic tubes in field application *now*.

Designed to cover X-band with minimum saturated CW power of 20 milliwatts (L-3266) and 2 watts (L-3236), they may be operated in cascade to amplify signals as small as −50 dbm to the 2 watt level. Their performance, far exceeding the conservative specifications, is evident in the accompanying graphs. Small size (less than 12″ in length), light weight (under 4 pounds each), and extreme environmental capability (temperature compensated −54°C to 86°C) make these tubes the ideal choice for military applications. A typical airborne equipment designed and manufactured by Granger Associates of Palo Alto, California, incorporates the L-3266 and L-3236 and occupies only 0.75 cubic feet, including all necessary power supplies, modulating circuitry, cooling, etc. This equipment is now in field operation.

If your work involves ECM repeaters, radar target enhancement, frequency diversity radar or any application requiring broadband microwave amplifiers, appraise these new tubes. In production quantities their price is the lowest in the field. Ask for catalog sheets on the L-3266 and L-3236. Address: Litton Industries Electron Tube Division, 960 Industrial Road, San Carlos, California.





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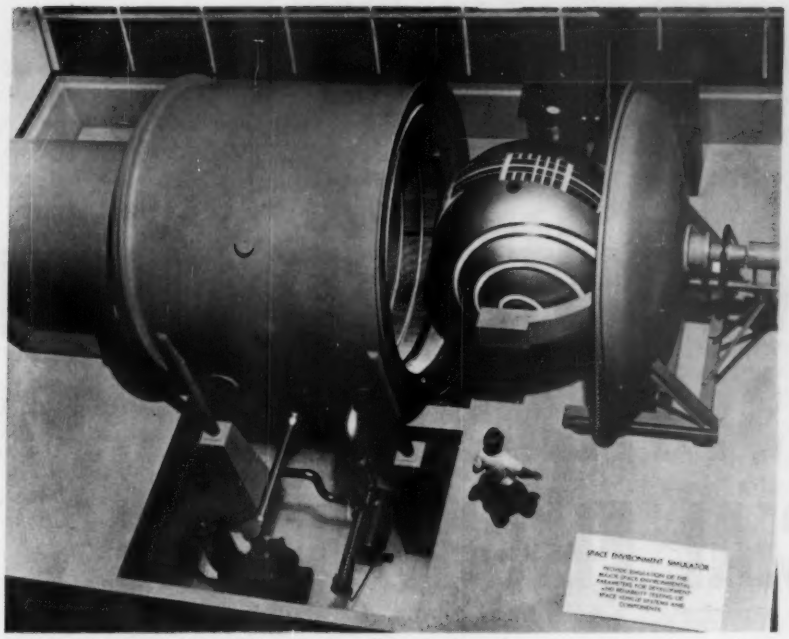


SPACE ENVIRONMENT CONDITIONS will be duplicated in the simulator shown above, designed to take a variety of payloads up to 8 ft. dia.

Vought Space-Flight Test Center

Dallas, Tex.—A space flight and equipment test center is being built here by Chance Vought Corp.'s Astronautics Division for use on its own projects, with expectations that it will also be made available to government agencies and industry on a "time-available" basis on contract.

Completely company funded and designed, the new center, to be completed in several months, will comprise:

• **A manned space flight simulator** to offer pilots realistic environments and operating conditions, capable of providing training for varied space missions including earth orbitings and landings, moon and interplanetary flights, satellite rendezvous, lunar parking orbits and lunar landings and launchings. Pilot's compartment will be free to move on three axes and displays will provide crew with views of the earth, planetary horizons and star fields as they would appear on an actual flight. Crew will also experience heat, noise, vibrations and other sensations of an actual mission.

• **Space environment simulator** will be used primarily for developing and testing vehicles, power systems, temperature controls, communications, instrumentation, guidance and control systems, space suits, small propulsion units and other material at altitudes up to 200 mi. It will permit simulating temperatures to −320F and will duplicate the sun's radiation spectrum. It is planned later to incorporate provisions for bombarding test articles with meteorite-like particles and possible nuclear particles. Capability of the simulator will provide capacity for payloads nearly eight feet in diameter and spin and rotate them to duplicate positions relative to the sun.

• **Automatic control systems** will undergo development and testing in the third simulator at the facility. A structure, floating on air to reduce friction, will permit checking of systems designed to control or stabilize space vehicles by means of reaction controls, inertia wheels and other novel motion-producing devices. The simulator can be operated by a man seated on a platform to determine human capabilities of the systems under test.

Sundstrand Tests Cryogenic Generator

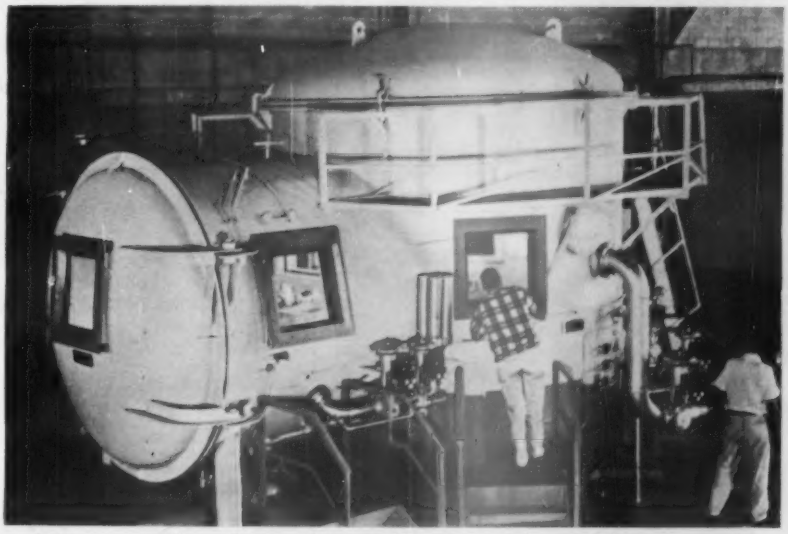
A fully integrated, cryogenic, thermal control and power generation system has been demonstrated during tests by Sundstrand Aviation-Denver. The tests were conducted in a chamber simulating a space vehicle wherein the turbine inlet was exhausted to an altitude of 130,000 ft.

The system maintained compartment temperature when electrical and hydraulic loads and turbine "in" temperatures were varied.

Sundstrand calls this new concept a hypercycle.

Maximum reliability and safety are attained in the device, Sundstrand maintains. For example, the maximum operating temperature is 165F, turbine blades run at room temperature, spontaneous combustion of leaking hydrogen cannot occur and the runaway speed of the turbine is less than the burst speed of the turbine wheel.

In addition, the hypercycle features low specific fuel consumption and has a hydrogen gas exhaust which runs at −375F which can be used for structural cooling, freezing CO_2 from the cabin and for reaction control without requiring supplemental hydrogen. Exhaust from a catalytic heater would also provide drinking water for the crew.



Tenney Simulator Installed at Cape Canaveral

Tenney Engineering, Inc.'s, Project Mercury high-altitude pod chamber, capable of simulating space conditions at an altitude of 45 mi., has been installed at Cape Canaveral. Dubbed "Mercury Pod", it will accommodate capsule containing first successful U. S. astronaut.

Knowmanship in Action

BENDIX TRANSISTORIZED FLIGHT CONTROL SYSTEMS LOG OVER 1,500,000 COMMERCIAL FLIGHT HOURS

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On the record, Bendix® automatic flight control systems qualify as the world's most experienced, most versatile for jet-age aircraft. Besides having flown more than 1,500,000 hours and over half a billion miles with the world's leading airlines, they have logged uncounted hours and miles on aircraft in the daily service of the U.S. and Canadian Air Forces and Navies.

In May 1957, the Bendix PB-20 became the first transistorized flight control system approved for airline use. Variations of it have since become operational on a great diversity of aircraft ranging from the world's first supersonic bomber—the Air Force's B-58 Hustler—to the world's tiniest jet-powered nuclear weapon carrier—the Navy's A4D-2N—and including the gigantic C-133A prop jet transport, the luxurious 707, 880 and Electra airliners, the RCN's deadly CL-28 submarine hunter and killer, and a host of other domestic and foreign aircraft.*

Dependability of these systems is underscored by the fact that many components have earned approval for an 8500-flight-hour overhaul schedule. Bendix flight control experience extends across many fronts including successful performance on rotary winged aircraft and a completely solid state design that already has logged flight time. Our record in the field of flight controls is a direct result of more than 40 years of close association with the operating needs of all kinds of air vehicles.

Another important current activity is a program to develop, build, and test hot gas systems for semi-orbital vehicles and missiles. Further proof that you can continue to look to E-P KNOWMANSHIP for major breakthroughs in flight controls, instrumentation, and components for aircraft, missiles, and space vehicles.

A complete list of the 40 operators and 15 aircraft types which employ Bendix transistorized automatic flight control systems is available on request.

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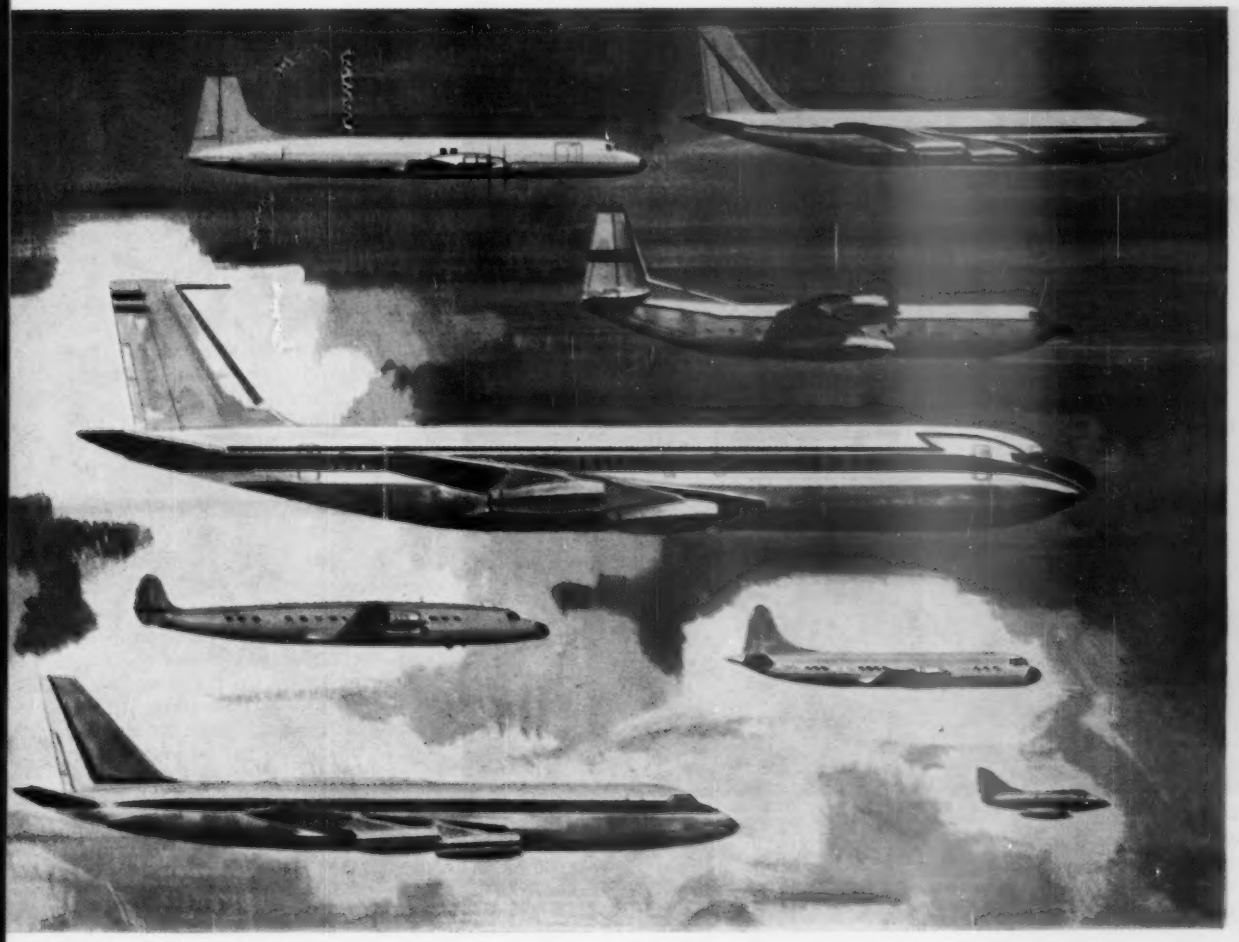
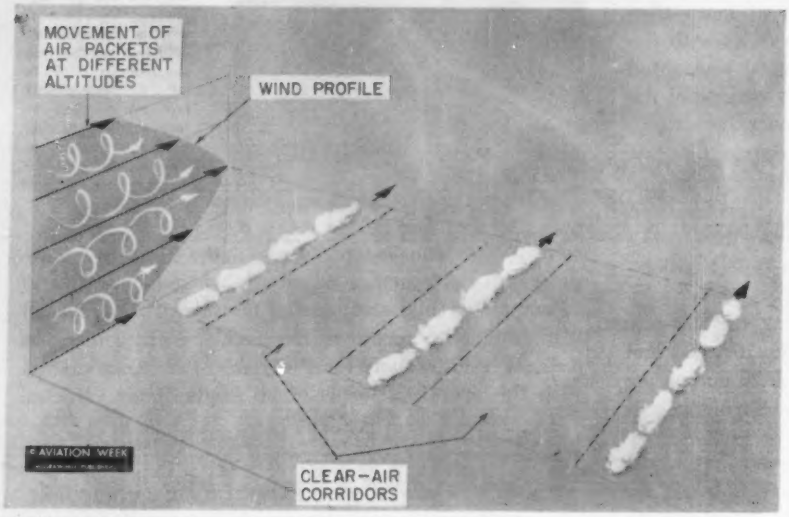
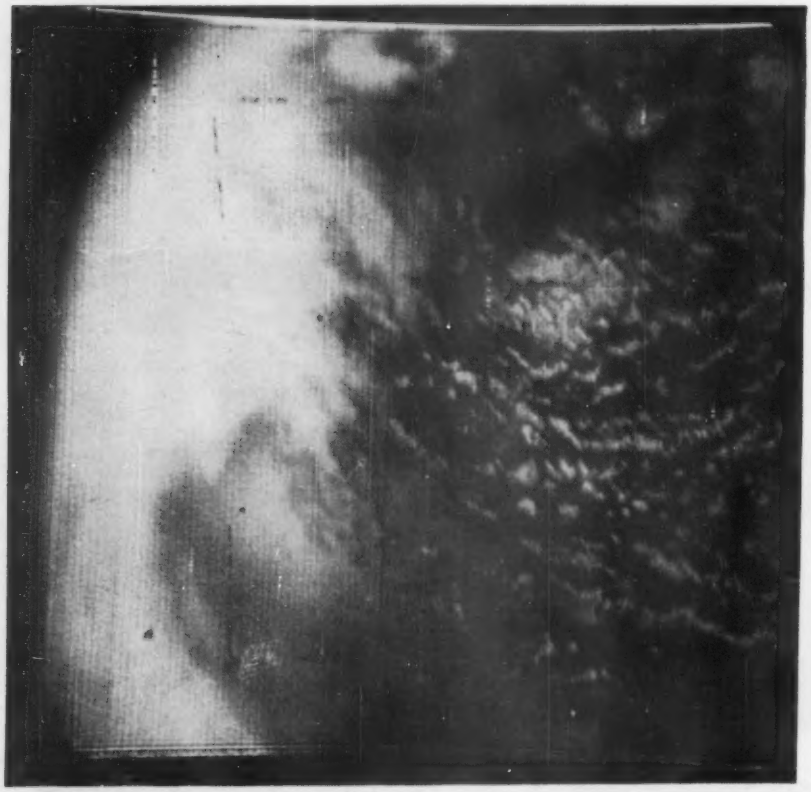


Tiros I Shows Large Storms Have Vortex



CLOUD band formations are caused by convection cells within jet streams. Each cell, where air packets continually circulate in a helical manner, comprises an updraft, where clouds form, and downdraft, an area of cooling and drying air. Rising to the top of its jet stream, an air packet is tumbled off to one side by the shearing force of the jet stream above (or below) and then, cooling, forms a clear-air corridor.



CLOUD band formations are visible in right half of photograph above. Storm, which was observed by Tiros I over the North Pacific, is large white cloud area to the left. Storm systems, photographed at various stages of development, ranged from 500 to 1,000 mi. in width. In all but two cases the vortex was found within a 350-mi.-dia. circle measured from the center of the low-pressure area.

By George Alexander

New York—Photographs from Tiros I weather satellite have revealed that large cyclonic storms contain a vortex at the storm center and that banded cloud formations are formed by convection and the shear forces of jet streams at different velocities and altitudes.

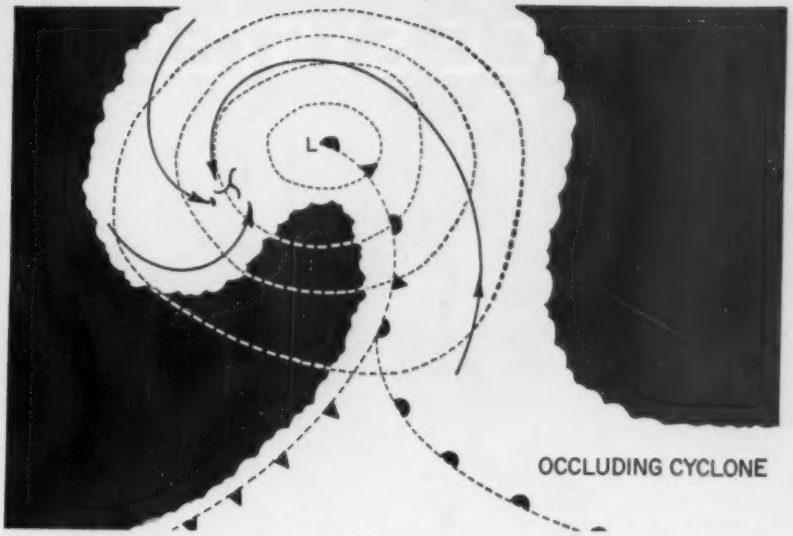
Roland J. Boucher, Allied Research Assoc., Boston, Mass., told the annual meeting of the American Meteorological Society here that vortices had been previously thought to be a feature only of tropical storms. But each of the 40 cyclonic storms photographed by Tiros I in mid-latitude of the northern hemisphere contained a vortex at the storm center, he said.

These storm systems, photographed at various stages of development, ranged from 500 to 1,000 mi. in width. In all but two cases, the vortex was found within a 350-mi.-dia. circle measured from the center of the low pressure area and, with eight exceptions, was located within the southwestern quadrant of this circle.

Growth of these storms, Boucher said, appeared to be along classical lines (i.e., a warm and a cold front meeting broadside and then forming into an occluding wave). Although this phenomenon is usually obscured by vast cloud sheets, Tiros I observed several instances where the frontal zone was between two relatively unclouded areas and the photographs show the developing storm as a bulging of the frontal cloud band.

Boucher said it is as yet unknown at which stage of the storm's development the vortex pattern appears, but all photographs of partially-occluded cyclones contain the unmistakable swirl. Further, Tiros I noted a feature peculiar to this phase: a wedge of essentially clear air tucked into the fast-forming hook of the cyclone. Boucher said that it is believed to be an area of subsiding dry air behind the cold front. As the storm matures, the wedge of clear air spirals in toward the vortex center and some measure of the cyclone's maturity may be estimated from the number of clear-air loops around the vortex. As the storm breaks up, the cloud formations arrange themselves in long spiral bands around the vortex, much like a pinwheel, with large clear gaps between. When this point is reached, Boucher said, the cyclone is front-less and it decays rapidly.

Dr. Joachim P. Kuettner, NASA Marshall Space Flight Center, Huntsville, Ala., said that long cloud band



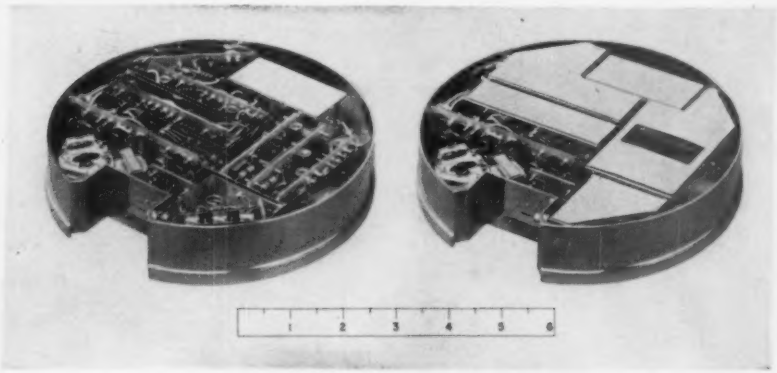
OCCLUDING STORMS resemble this drawing. (White is cloud; black is clear area.) Note wedge of clear air intruding toward vortex and low pressure center (L). At this stage of development, a storm would be almost at full maturity.

formations—long straight rows of clouds separated by clear-air corridors, usually found off the storm's warm front—appear to form through the interaction of a specific type of convection and the shear forces of different jet streams.

According to Kuettner, the jet streams establish convection cells within their altitude bands. As packets of warm, moist air rise within the stream, they are cooled and then tumbled off to one side (clockwise if below the strongest jet stream; counterclockwise if above it) by the shearing effect of two different jet streams, moving along in a helical manner. Clouds are thus structured at right angles to the direction of the wind flow. Clear-air corridors between rows of clouds are areas of downdrafts.

NASA has announced that the wide-angle camera aboard Tiros II was shut down in mid-January because of a malfunction of the timing clock. Had the system been allowed to continue, NASA said, there would have been a heavy drain on the power supply, thus jeopardizing the infrared system which is measuring the earth's heat budget.

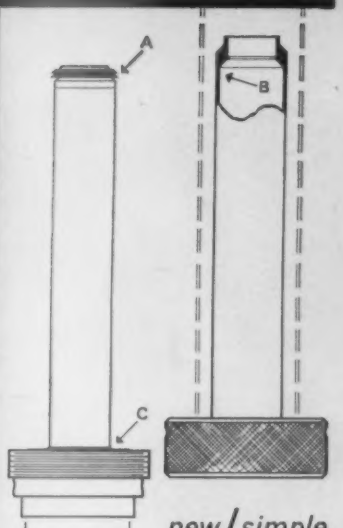
The wide-angle camera took 11,102 photographs, of which 9,524 were judged to be useful. The narrow-angle camera has taken 894 pictures, of which 545 were considered to be useful. NASA has said that although the quality of Tiros II photographs does not equal those of Tiros I, the photographs are not worthless for use in meteorological study, as has been reported in some instances.



Avco Develops Miniature Receiver

Miniature command receiver for use in satellites, developed for National Aeronautics and Space Administration by Avco Corp.'s Electronics and Ordnance Division, measures 6.3 in. in diameter by 1.13 in. high, weighs 1.5 lb. Receiver consumes only 0.2 watt of power during operation, only 0.1 watt during standby condition. Avco also has developed a two-pound decoder unit, for use with command receiver, which can activate or turn off equipment in the satellite, accepting up to seven separate commands.

CRYOGENICS



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SPACE SYSTEMS:

FROM TALENTS TO HARDWARE

LOOK TO GENERAL PRECISION FOR DEVELOPMENT, PRODUCTION AND SYSTEMS MANAGEMENT

The talents and capabilities of the four divisions of General Precision, Inc., are heavily represented in the latest space systems, as well as in space-age hardware and weapons of all categories. The divisions are responsible for some system, subsystem or component on virtually every space vehicle, satellite, missile, rocket and aircraft now in operation or development.

To make these broad capabilities available to the fullest of their combined potential, General Precision, Inc., has consolidated its four divisions for the systems management of major new space and weapons projects.

A major space program can now draw upon more than 2½ million square feet of combined General Precision floor space and over 16,000 General Precision employees, including 4,500 scientists, engineers and technicians.

This combination of talents and facilities, backed by the corporate financial resources of General Precision, Inc., makes it possible to develop, produce and manage a space system as an integrated package.

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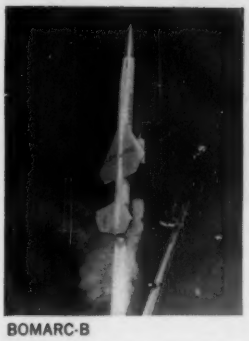
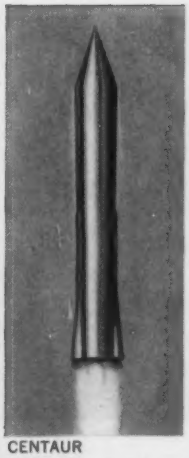
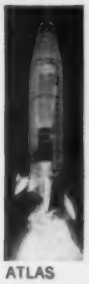


BOMARC-B

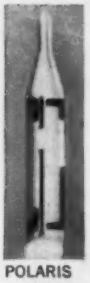
B-70



CENTAUR



ATLAS



POLARIS

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- PERSHING
- POLARIS
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- BOMARC-B
- SKYBOLT
- B-70
- B-52

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- FAA AIR TRAFFIC CONTROL

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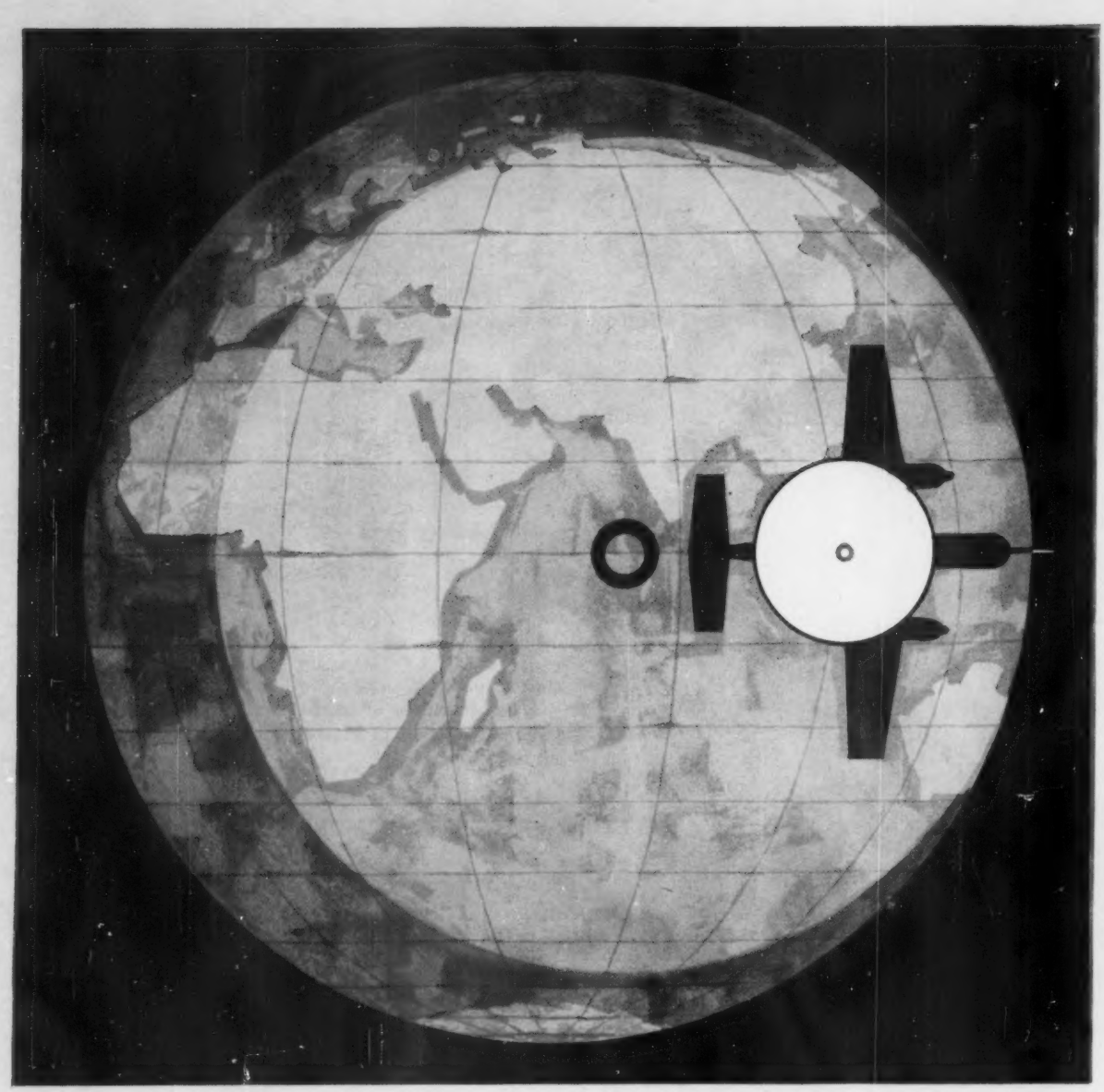

Brunswick Rotodomes - New Eyes and Ears of the Fleet!

Grumman Hawkeye carrier-based A.E.W. aircraft with a Brunswick-built rotodome gives new early warning capability to the Navy.

The Dalmo-Victor Division of Textron Inc. assigned Brunswick the task of fabricating the newest and most sophisticated of rotodomes. Brunswick's vast experience in fabricating large plastic-metal structures of sandwich construction assured the customer and the Navy of receiving a completely reliable product.

This large, complicated structure is another example of Brunswick's capability in the field of reinforced plastics and metal honeycomb. Whether the requirement be for a small structural unit such as a missile radome operating at high frequency, a large composite structure such as the rotodome, large reflectors or ground domes, you can count on Brunswick's project experience to accomplish your most difficult assignments.

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Space Frequency Argument Taking Shape

Los Angeles—Squabble over what frequencies are to be used or whether presently allocated frequencies can be shared is taking shape as a prime issue in the fast emerging field of space communications, including commercial communications relay.

To find answers to these questions, Stanford Research Institute and the Central Radio Propagation Laboratory of the National Bureau of Standards were retained last month by a subcommittee of the Joint Technical Advisory Committee, an industry group jointly sponsored by the Electronics Industries Assn. and the Institute of Radio Engineers.

Frequency Allocation

The advisory committee previously had been asked by the Federal Communications Commission to study the controversial problem of frequency allocation for space communications (AW Jan. 9, p. 37).

Purpose of the Stanford-Propagation Laboratory work will be to conduct an impartial study of the technical problems involved in determining frequency requirements for satellite communications and other space functions. Last week Stanford Research representatives began canvassing laboratories and companies known to be actively interested in space satellites in an effort to gather technical facts about likely space system parameters and the frequency requirements of such systems.

Stanford and the laboratory will jointly determine what studies need to be undertaken to get answers to any unresolved technical questions. A preliminary report on their work is to be presented to the ad hoc Subcommittee on Frequency Allocations for Space Communications, in mid-February.

It will be discussed and presented to the main body of the Joint Technical Committee on Feb. 23.

March Deadline

This is to coincide with the Mar. 1 deadline which the Federal Communications Commission has set for response to its widely circulated request for data on the needs of frequency bands for space communications. As part of its long-range inquiry into radio frequency allocations needed for space communications (Docket 13522), FCC is asking a variety of industrial, government and public groups as well as technical organizations for written replies to eight specific questions concerning spectrum use, frequency sharing and intended experiments with space satellites. FCC wants to develop data before the International Extraordinary Administrative Radio Conference on Space Radio Communications tentatively scheduled for 1963.

Only last fall, FCC denied American Telephone and Telegraph's request that previous allocations of spectra above 890 mc. to private microwave users be set aside and that these frequencies be reserved for space communications (AW Oct. 31, p. 32). AT&T, supported by several other common carriers, contended at that time that unless the earlier allocation of these frequencies were reversed, necessary frequencies would not be available for space communication systems, thus restricting use of these systems or forcing undesired sharing of frequencies (AW July 18, p. 37). There is conflicting feeling in the avionics industry among those concerned with space satellites about whether special frequencies or a large band of frequencies need be set aside for space communications.

Differences over the need for special frequency allocations or possible frequency sharing reflect to some degree different technical approaches to communications satellites. AT&T, for example, favors a multitude of randomly orbited, low-altitude satellites which make frequency sharing with land systems difficult because of large numbers of radiating devices required. Proponents of the "stationary" satellite concept—active repeaters in a 22,300-mi. orbit above the earth's equator fixed with respect to given points on the earth—argue that large bands of the spectrum need not be set aside. They point out that because of the use of only a few directional antennas existing frequencies can be shared without interfering with land point-to-point microwave systems.

Stationary System Critics

In reply, critics of the stationary system cite both practical and theoretical objections to the stationary system. Boosters capable of placing a payload at least of the 175-lb. class proposed by AT&T into the stationary orbit are not now available. In addition, they contend that keeping the satellite in its fixed orbit requires a highly precise control system.

The theoretical question which has

Direct Binary Output Pressure Transducer

Edwards AFB, Calif.—Novel concept in digital pressure transducers which could have far-reaching effects in the aircraft and missile instrumentation fields if properly realized will be explored in a research and development contract to be awarded later this year by the Air Force's Flight Test Center here.

Air Force is seeking a pressure transducer which can directly provide binary outputs as a function of applied pressure without going through conventional analog-to-digital converters.

Binary outputs are to be suitable for magnetic tape recording. Representatives of nine southern California companies invited to a bidders briefing held here Jan. 16 were asked to consider new ways and means of designing the pressure transducer which will enable analog to be registered as digital phenomena.

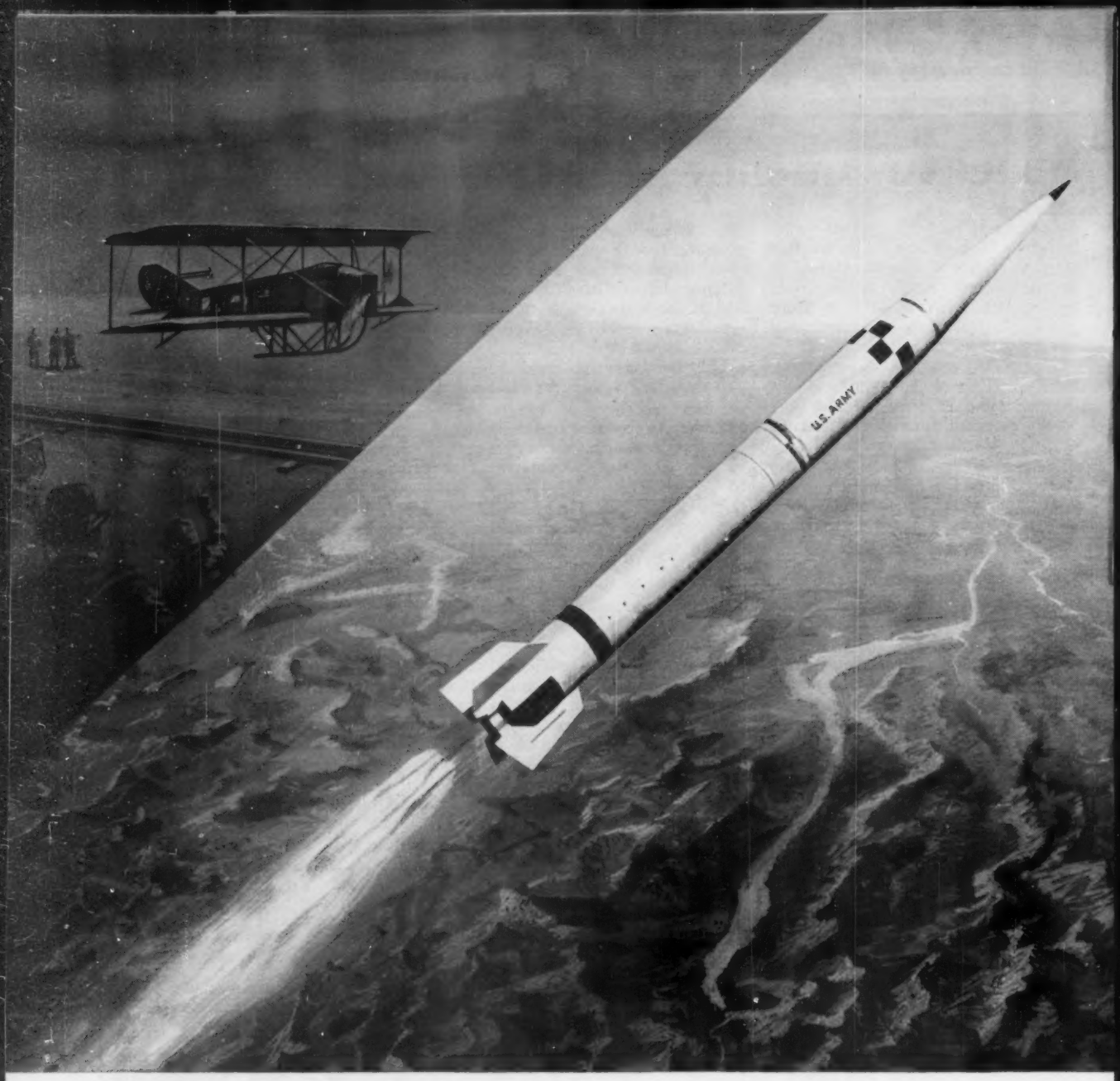
Analog to digital conversion will probably have to occur in the transducer itself. FM transducers, a cross in concept between analog and digital devices, were ruled out of consideration by the Air Force.

Proposals for the new transducer are due here on Feb. 15. An Air Force spokesman says about six proposals are expected.

No dollar value was specified for the projected transducer contract by the spokesman or by others at the bidders conference, but indications are that the contract will not exceed $250,000.

Potential contractor will be expected to design, develop, fabricate and evaluate the highly accurate transducer under Air Force direction. The transducer is to be small, easy to handle and simple in mechanical and electronic design, according to Air Force requirements. It is to have a broad range of operating parameters including operation from cryogenic temperatures (perhaps down to liquid nitrogen temperature) to 250F.

Possible applications for device will be measurement of pressure in liquid oxygen tanks, total and differential pressures in aircraft and missile instrumentation.



Missilry: 45 years ago, and today

There was a guided missile nearly a *half-century* ago. It was Sperry's Aerial Torpedo for the Navy—the world's first guided missile, 14 feet in length, and with a range of 50 miles at 90 mph.

Since then, a family of missiles and of missile guidance systems of ever-increasing power—and "brainpower"—has evolved at Sperry. Notable was the Navy's Sparrow I, the first operational air-to-air missile. An outstanding example today—when it becomes operational—will be the Army's Sergeant, for which Sperry is prime contractor. A medium range, surface-to-surface, inertially-guided ballistic missile, Sergeant has had a brilliant record of successful test firings. It is highly mobile and easy to operate—approaching conventional artillery in speed of emplacement and displacement.

In systems and components for missiles, too, Sperry has made major contributions. For the Army's Nike Zeus – the nation's only anti-missile missile system now in the advanced development stage for intercepting ICBMs—Sperry developed for Bell Laboratories and Western Electric extended range target tracking and discrimination radar transmitters. Other Sperry radar systems acquire, track and guide the Navy's Terrier and Talos missiles, providing precision fire control for missile cruisers, destroyers and carriers.

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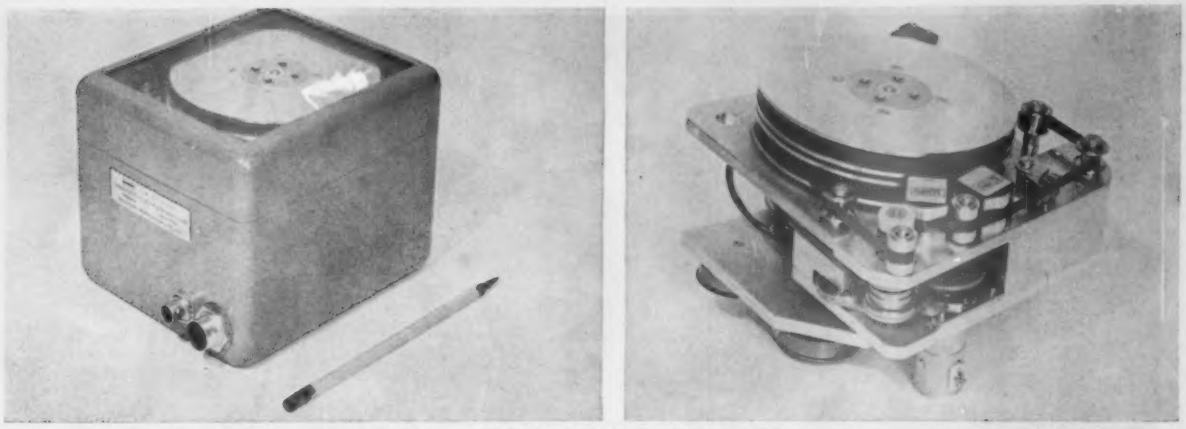


Tape Recorder Designed for S-16 Solar Phenomenon Satellite

Low-power satellite tape recorder designed as a backup device for use in forthcoming S-16 Solar Phenomenon satellite (a joint NASA-Ball Brothers Research Corp. project) draws only ¼ watt of energy during recording, ½ watt on playback—a substantial reduction from the 10 watts required by similar recorders made by the same company for the Courier satellite program. Power reduction was made possible by the use of a d.c. motor employing rolling rather than sliding brushes, pickup head for speed correction and a negator spring system. Final model of the breadboard version of the reel-to-reel recorder shown here will occupy about 100 cu. in. Recorder's characteristics include 1 ips. record and 18 ips. playback times, storage of 900 ft. of ¼-in. wide, 1-mil thick tape. The recorder is being developed by Advanced Electronics Data Laboratory, a division of Consolidated Electrodynamics Corp.

been raised is that of "echo delay." This involves the time—roughly 0.54 sec.—that it takes a telephone message to travel from earth to the satellite and back again to the earth. Hence, a party talking over telephone via a stationary satellite would hear his own voice delayed in time. One suggested means of avoiding this is to use an echo suppressor which effectively locks out one party while the other is speaking. This in turn might prevent normal conversational give and take, such as interruptions of one party by the other. The echo problem does not affect television relay by stationary satellites.

Technical arguments have been advanced by engineers to support their respective companies' views about the annoyance or severity of the echo delay problem.

Now, however, it is reported that scientists at Stanford have conducted demonstrations of the echo problem and concluded that while the echo is noticeable, it is not objectionable. While no official comment was available from Stanford, it is understood that the results of this work were reported to the National Aeronautics and Space Administration which is about to begin an experimental low-altitude communications satellite program (AW Jan. 23, p. 30) and may be included in Stanford's report to the Joint Technical Advisory Committee.

The possibility that objectionable interference created by low orbiting satellites transmitting in the same frequency bands as land-based microwave systems can be minimized or eliminated also has been raised. One important area of the Central Radio Propagation Laboratory's study will be to determine the extent to which frequencies can be shared. The laboratory's efforts will be more extensive than that required by its Joint Technical Advisory Committee work because of its recognition of the growing importance of space communications, a spokesman for the bureau's Boulder Laboratory said. AT&T plans to look into ways of minimizing interference in its one-year space communications experiment, authorized by the Federal Communications Commission earlier this month.

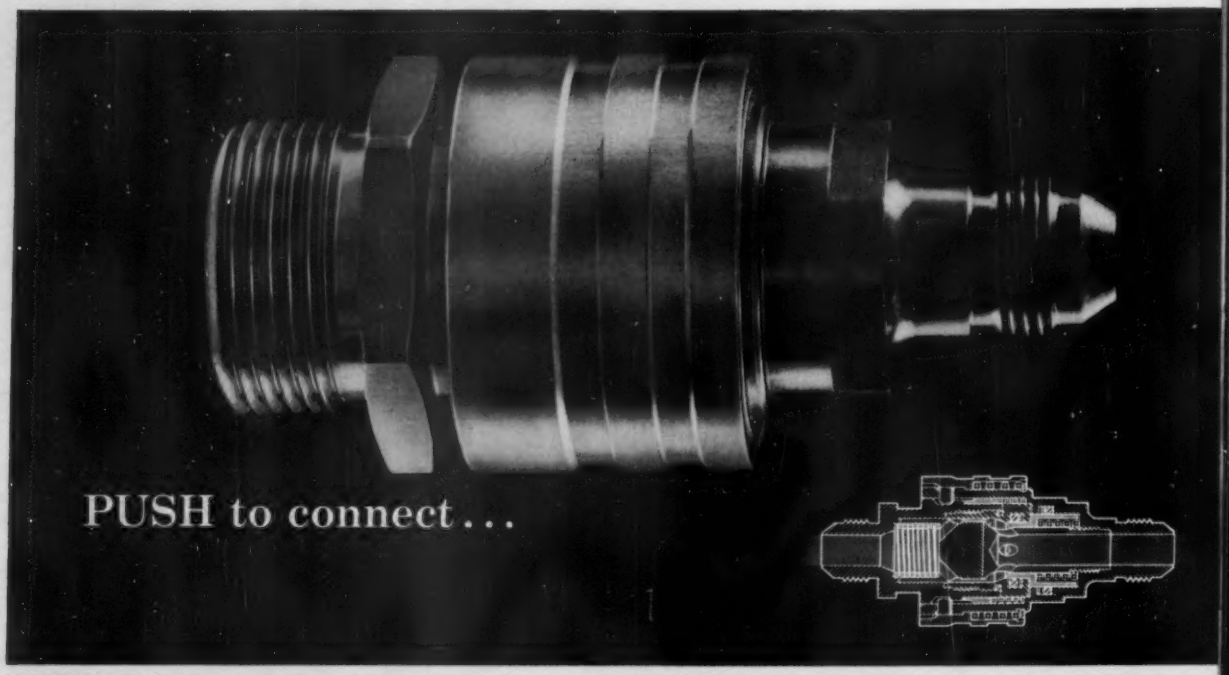
Coming months may see an increasing number of organizations taking or shifting positions on the various problems associated with frequency spectrum use for space satellites. Indications are that the American Rocket Society will "clarify" the strong position it took on the allocation of space frequencies last December. At that time, the general counsel of the society filed a petition for a reversal of FCC's decision refusing to reallocate frequencies above 890 mc. on the grounds that the FCC decision "vitally and adversely affected the allocation of radio frequencies for use in space activities." Feeling in the society is that this action was taken without adequate consideration. The group may shortly restate its attitude which will be to suggest that a few frequencies, not the broad bands, be set aside for space purposes and that the society will be willing to furnish data on capability of rockets.

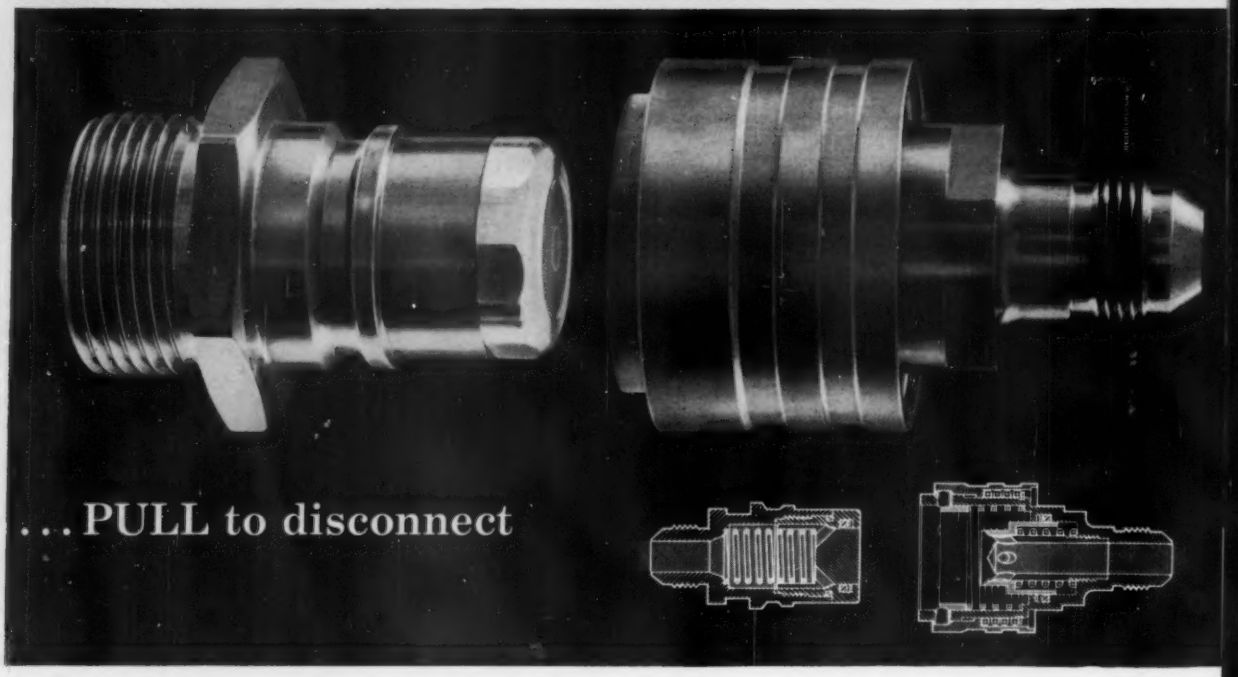
The questions on space frequencies to which FCC is seeking written replies are in summary:

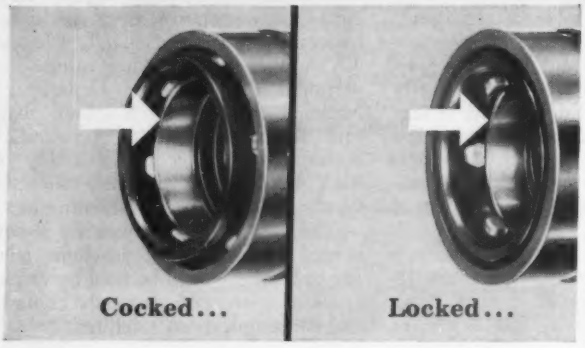
- **What is the nature** and extent of experiments conducted or in progress involving frequency emission for space communications?
- **What portions of spectrum** are needed for all forms of space communications? When will these be needed and does each require the same degree of protection from interference?
- **Can or should frequencies** used for space be shared with other services?
- **Do non-government groups** plan communication satellite launchings?
- **How can those groups** which do not plan their own satellites gain access to active communication satellites?
- **Should there be separate** or shared frequency allocations for government and non-government space communications?
- **How will space communication** receivers be situated geographically?
- **What purposes** will space communications serve that existing communications facilities do not now satisfy?

In forming the ad hoc subcommittee last fall, an effort was made to obtain services of persons with broad experiences in many fields according to a subcommittee spokesman. Members include representatives from Associated Universities, Inc., General Electric, NASA, NBS, Tele-communications Department of the State Department, National Academy of Sciences, Stanford Research Institute, Aeronautical Radio, Inc., Lincoln Laboratory of MIT, Bell Telephone Laboratories and General Telephone and Electronics.

The subcommittee primarily is concerned with technical problems relating to frequencies to be used by various types of spacecraft, not only commercial communications satellites.







Locking Mechanism Cocked, Triggered, by Coupling Action. As collar is pulled backward for disconnect, trigger ring moves forward in socket, automatically "cocking" the locking pins for the next coupling action. On connect, as the nipple is inserted into the socket, a raised diameter on the nipple trips the trigger ring; locking pins are instantly cammed into the locking position, pulling nipple into positive lock in socket.

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NEW, trigger-fast action keeps air out...fluids in

Jack & Heintz TRIGGER LOCK Couplings meet aerospace needs for instant sealing, quick disconnect, longer service life.

Fluid loss on disconnect can mean burns, explosion hazard, toxicity. Admission of air or foreign matter on connect can interfere with hydraulic system stability and control. This new coupling by Jack & Heintz provides new high sealing efficiency to meet these increasingly vital problems.

TRIGGER LOCK is a Minimum-Spillage No-Air Inclusion Coupling. Designed to meet all requirements of MIL-C-25427, field tests on ½" coupling show less than 2.2 cc spillage on disconnect and a maximum of 0.10 cu. in. air inclusion during connect.

TRIGGER LOCK's flush-faced piston-type valves prevent leakage, reduce pressure drop. Sealing action in both socket and nipple is accomplished by piston-type valve design. Each valve has ports serving as fluid passages. Ports cannot be uncovered during connect until *after* a perfect seal exists between socket and nipple. This action insures absolute minimum fluid spillage and air inclusion. This design also keeps pressure drop at minimum . . . ¾" coupling shows pressure drop of less than 4.1 psi at 16 gpm using MIL-O-5606 hydraulic fluid.

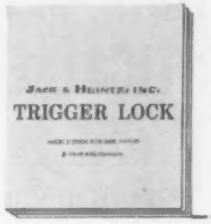
TRIGGER LOCK's axial action simplifies access, permits remote control. Connect and disconnect action are straight-line axial . . . one push connects, one pull on collar disconnects. No twisting or rotating is required. This means easy coupling access, and also permits ready adaptation for "breakaway" or remote actuation.

TRIGGER LOCK's lightweight, small size is ideal for restricted space applications. Made of aluminum and incorporating simplified sealing and locking mechanisms, Trigger Lock facilitates designing into smallest possible space envelopes and keeps flight package weight to a minimum.

TRIGGER LOCK's seal design increases pressure, temperature capabilities. All seal contact surfaces are compressed uniformly, enabling the O-rings to seal against very high pressures or vacuums. Uniform O-ring squeeze means long service life over wide range of fluid and ambient temperatures.

TRIGGER LOCK is adaptable to wide range of fluids. Although designed primarily for hydraulic systems, Trigger Lock is readily adaptable for use with other fluids through changes in basic construction materials and/or seals.

TRIGGER LOCK is available in standard or special designs. The Jack & Heintz Trigger Lock No-Air Inclusion Couplings, coded Series 17, are available in standard models from ¼" through 1¼"; no size limit on special designs.



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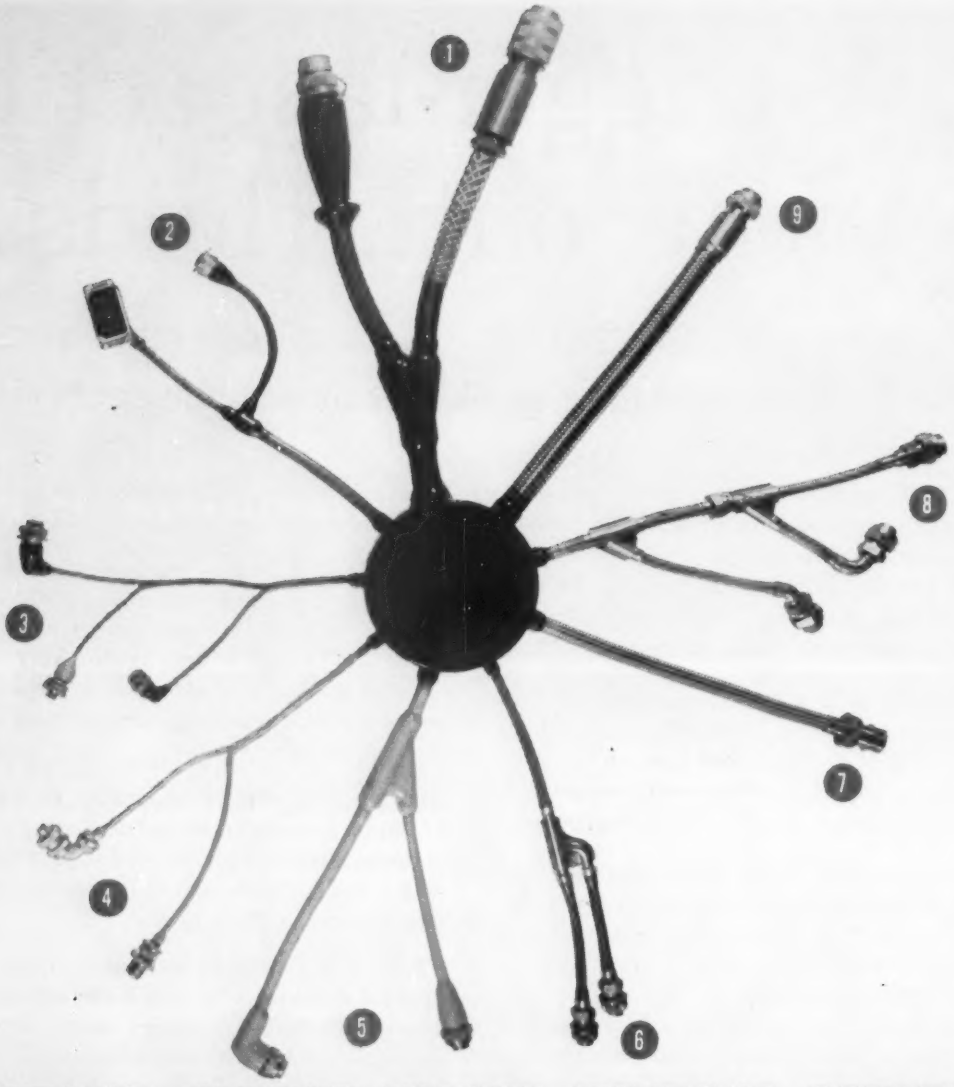

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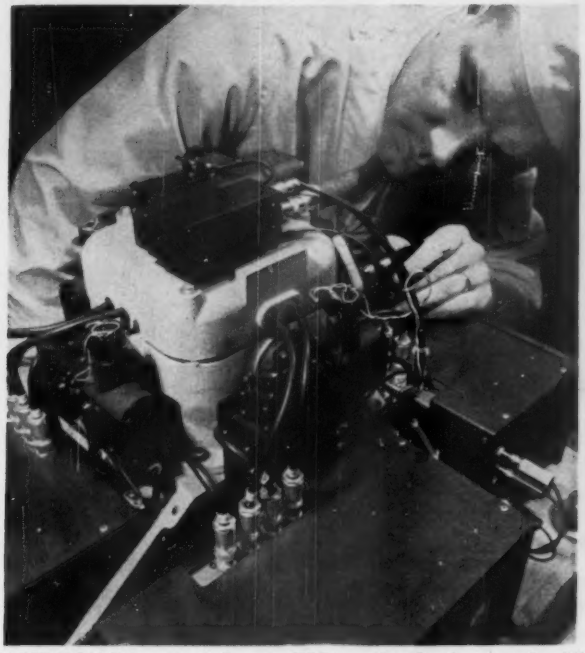

ELECTRICALLY suspended gyro (ESG), under development by Minneapolis-Honeywell, is expected to have sufficiently low drift to permit its use as a precise directional reference in Polaris submarines. The new type gyro also is promising for space vehicle applications. Photo at right shows the attaching of one of several high-voltage leads which produce electric field that supports spinning spherical rotor. Vertical and horizontal coils surrounding gyro inner element induce magnetic fields which set rotor spinning.

Navy to Test Electrically Suspended Gyro

By Philip J. Klass

Minneapolis—Electrically suspended gyro, with drift rates that would have been considered fantastic a decade ago, is expected to find its first use aboard Polaris submarines as an extremely precise azimuth reference.

The ability to obtain an extremely accurate azimuth reference under adverse weather conditions when star sights are not possible should increase the flexibility of the submarines and improve target accuracy of the Polaris missiles.

This explains the Navy's interest in electrically suspended gyros (ESG) and its support of the ESG program here at Minneapolis-Honeywell. The company now has several experimental ESGs on test and hopes to deliver a prototype to the Navy for sea tests during the coming year.

Space Applications

The electrically suspended gyro, and the cryogenic gyro with drift rates in the order of 0.0001 deg./hr. (AW Feb. 1, 1960, p. 72.), both look promising also for mid-course guidance of space vehicles where extremely low drift and long life are important requisites.

Scientists at the University of Illinois, working under Dr. Arnold Nordsieck, pioneered in the development of electrically suspended gyros under joint service sponsorship. After University of Illinois had established ESG feasibility, the Navy launched programs at American Bosch Arma, General Electric and Honeywell. The Honeywell effort is the only one of these three now receiving Navy funding.

Air Force currently is sponsoring ESG programs at both General Electric

FIRST PHOTO of Polaris inertial guidance system package, developed by Massachusetts Institute of Technology's Instrumentation Laboratory. Inertial guidance is manufactured by General Electric and Hughes Aircraft, which recently was set up as a second source. Polaris system uses three-gyro stabilized platform and digital computer.

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and Honeywell, presumably for space vehicle guidance applications. Honeywell expects to deliver an ESG to Wright Air Development Division this spring.

In concept, the ESG is relatively simple. It consists of a rotating ball suspended within a shell by means of electric fields, providing a two-axis-of-freedom gyroscope. There are no bearings, with their attendant problems of friction and spurious forces which can cause gyro drift. Except for the spinning ball, there are no moving parts. The absence of any wearing surfaces suggests extremely long and reliable operation.

Low Drift Rate

For security reasons, Honeywell does not disclose specific ESG performance figures. However, Robert Maze, in charge of ESG engineering, says the drift rate is so low that it makes testing difficult because the gyros must be operated for extremely long periods of time before the drift is great enough to be detectable. To cut test time, Honeywell often operates the spinning rotor at a fraction of normal operating speed, which steps up its drift proportionately.

Another indication of the range of ESG accuracy can be gained from Maze's statement that the first experimental ESG, which Honeywell built nearly two years ago, exhibited significantly lower drift rates than the best floated gyro which the company was building at that time.

The rotor consists of a 3-in.-dia. ball of beryllium, supported inside a ceramic case by electrostatic fields produced by electrodes within the case to which high voltage is applied. The case is evacuated to provide a vacuum comparable to that found in receiving tubes.

The rotor is brought to operating speed, usually around 24,000 rpm., by means of a rotating magnetic field produced by coils excited by high frequency power. Once the spinning ball is brought to speed, power is removed and the gyro rotor will spin for days before power must be applied to raise its speed.

Because the rotor has no physical contact with its case in normal operation, optical sensors must be used to measure displacement of the gyro case with respect to the spinning ball, instead of using synchro pickoffs employed with more conventional gyros.

Honeywell uses three pairs of optical sensors which peer through windows in the ceramic case to view special grid markings on the spinning ball. These same optical sensors also provide a means for checking the centering of the ball within the case, and automatically adjusting suspension electrode voltages as needed to achieve centering.

Design Problems

Although the electrically suspended gyro is moderately simple in concept, its design poses many challenging problems. One of the most difficult, and fundamentally important, is to produce uniform rotor spheres. At rotation speeds of 24,000 rpm., and with a clearance of only a few thousandths of an inch between the spinning ball and its suspension electrodes, the rotor dimensions must be maintained to extremely close tolerances. The sphericity of the ball is held to better than five millionths of an inch during manufacture. Beryllium is used to give high dimensional stability during subsequent operation. After the sphere has been machined and ground, Honeywell laps it to a high finish, much like a small ball bearing.

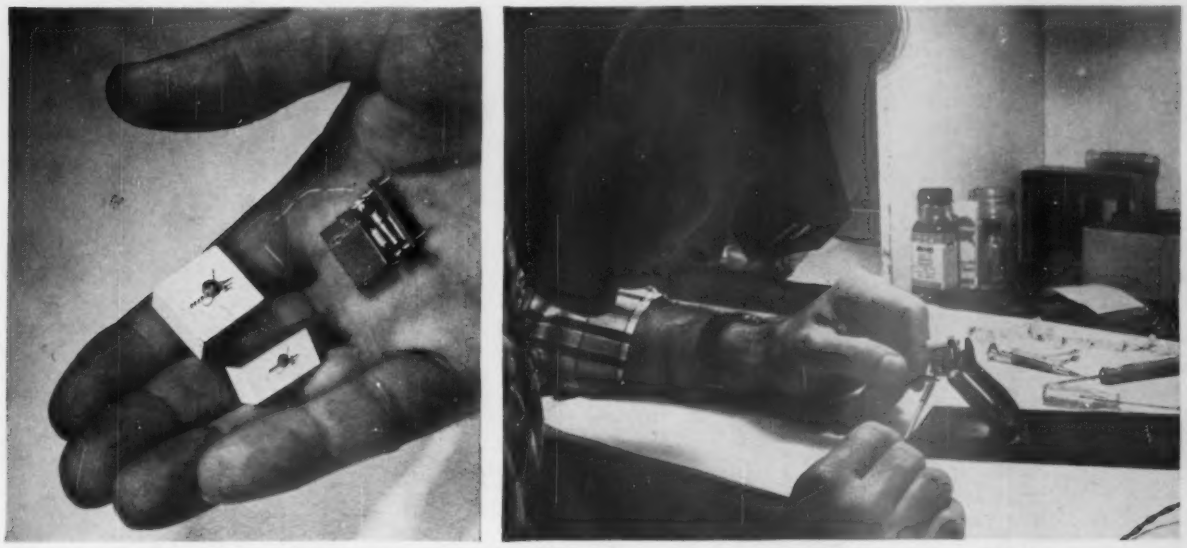
The ball is carefully balanced by drilling out holes in the sphere and filling them with appropriately located plugs of material of different density.

Ceramic Case

Another challenging, if less difficult, problem is to produce a well-sealed ceramic case so the required hard vacuum can be maintained without need for external pumping equipment.

The cryogenic gyro, whose spinning sphere is supported in a vacuum by magnetic instead of electric fields, faces many of these same design problems but with the added requirement that the sphere must be maintained at near absolute-zero temperatures. It appears likely that many techniques developed for one type will find use in the other. General Electric is developing both types, and Honeywell recently has initiated work on a cryogenic gyro.

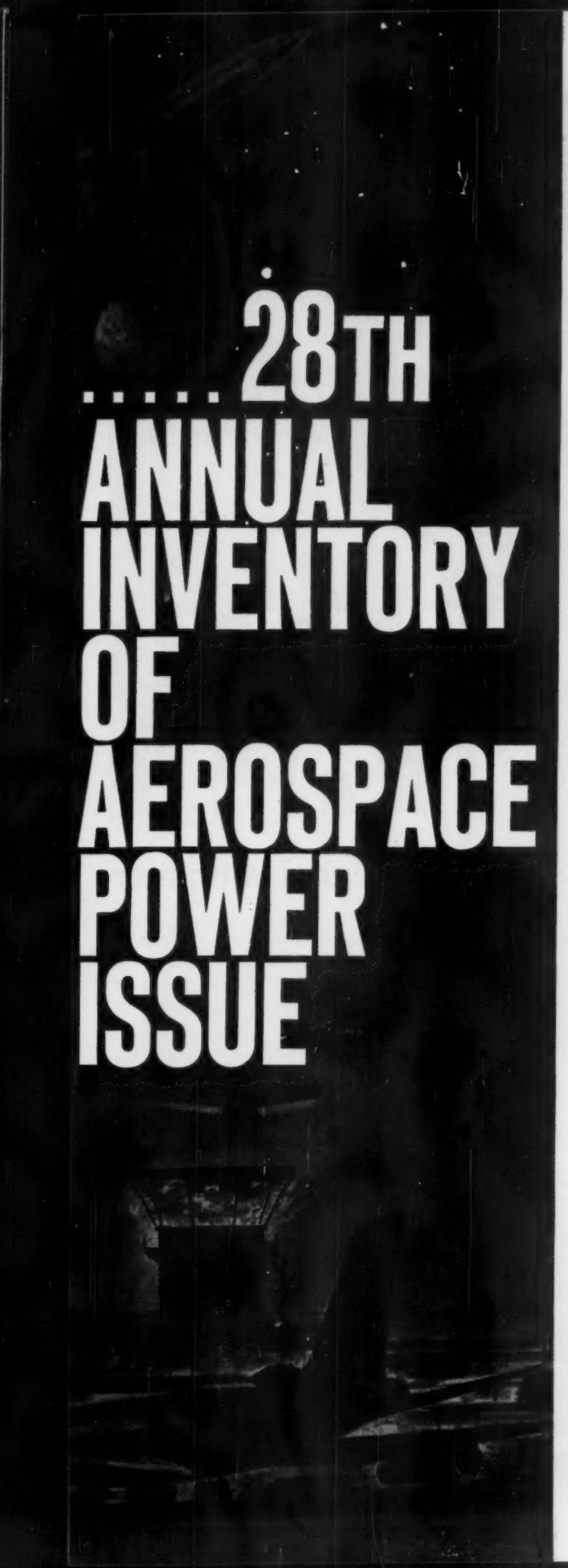
Maze is bullish over the future of the ESG because it employs electric fields and torques whose cause-and-effect relationships are well understood and can be described mathematically. By contrast, he points out that the performance of a conventional floated gyro depends upon random torques and forces which are extremely difficult to



Biological Telemetry Device Transmits Physiological Data

Biological telemetry package which can transmit physiological data from the body of a man to a remote receiver is shown (left) before and after final assembly. Smaller rectangular unit is battery supply which accepts the larger plug-in unit containing sensor, amplifier and FM transmitters. Entire "Mini-sensor" (AW Dec. 19, p. 61), made by Douglas Aircraft, can be attached to the body with surgical adhesive. Advanced model under assembly (right) will be tunable from 88 to 108 mc.

MARCH 13, 1961. .



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measure and whose effects are difficult to predict.

With additional experience, Honeywell believes it can produce ESGs at costs comparable to those of high-quality floated gyros, but with vastly better accuracies, according to John Forsmark, product manager of company's marine systems group.

Even greater accuracy can be expected when the gyro is used in a zero-gravity environment for space vehicle guidance. Some observers predict that in this environment, an ESG might operate for a year with a drift of less than one degree.

The importance of midcourse guidance for interplanetary probes was emphasized during the recent Dallas meeting of the American Astronautical Society in a report by D. F. McAllister of North American's Autonetics Division

Without midcourse guidance, an error of only 1 fps. in engine cutoff on a Venus probe would result in a 10,000-mi. miss of the planet, while the same velocity error would produce a 20,000-mi. miss for a Mars probe, McAllister pointed out. Even without an initial velocity cutoff error, the present uncertainty in the astronomical unit itself could cause a space vehicle to miss Mars by 70,000 mi. if no midcourse guidance were used.

Electric Suspension

The potentially long life and low drift of the ESG and cryogenic gyros make them appear attractive for such space applications, McAllister said. In the zero-gravity environment, considerably smaller power supplies could be used for electric suspension, and the problem of maintaining vacuum would be greatly eased. For the cryogenic gyro, the low temperature of space would ease the cooling problem, McAllister said.

Because both the ESG and cryogenic gyro give their best accuracy when operated as displacement gyros, Autonetics is investigating a midcourse guidance system which would use them as strapped-down gyros, i.e., without a gyro-stabilized platform. In such a system, the gyro package would be rigidly fixed to the space vehicle frame.

A small, high-speed digital computer would be used to convert output signals from the gyros to nine direction angle cosines which relate the space vehicle's orientation to a set of inertially fixed axes. These would be used to convert the output of three accelerometers to a space-fixed coordinate reference for computation of space vehicle velocity and distance traveled.

The system described by McAllister also would employ a star tracker to provide occasional position fixes with which to correct for drift of the gyros.

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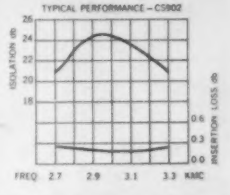

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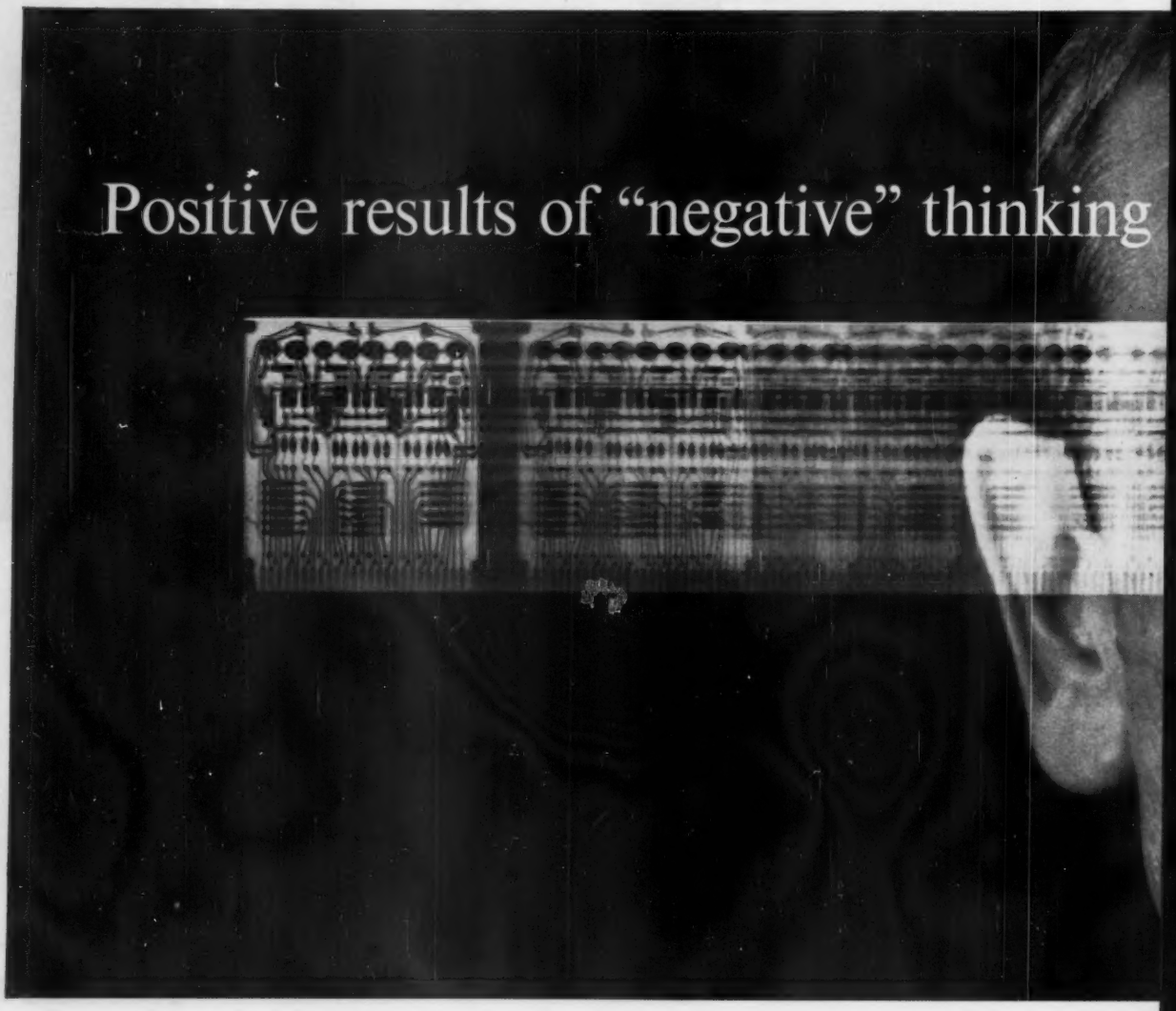

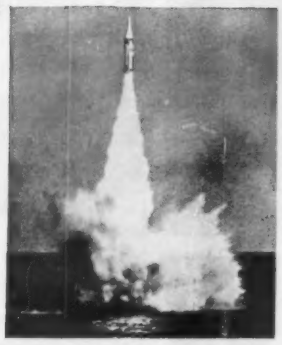

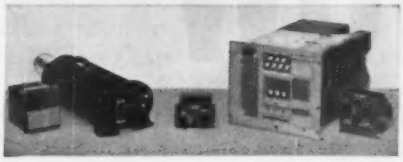

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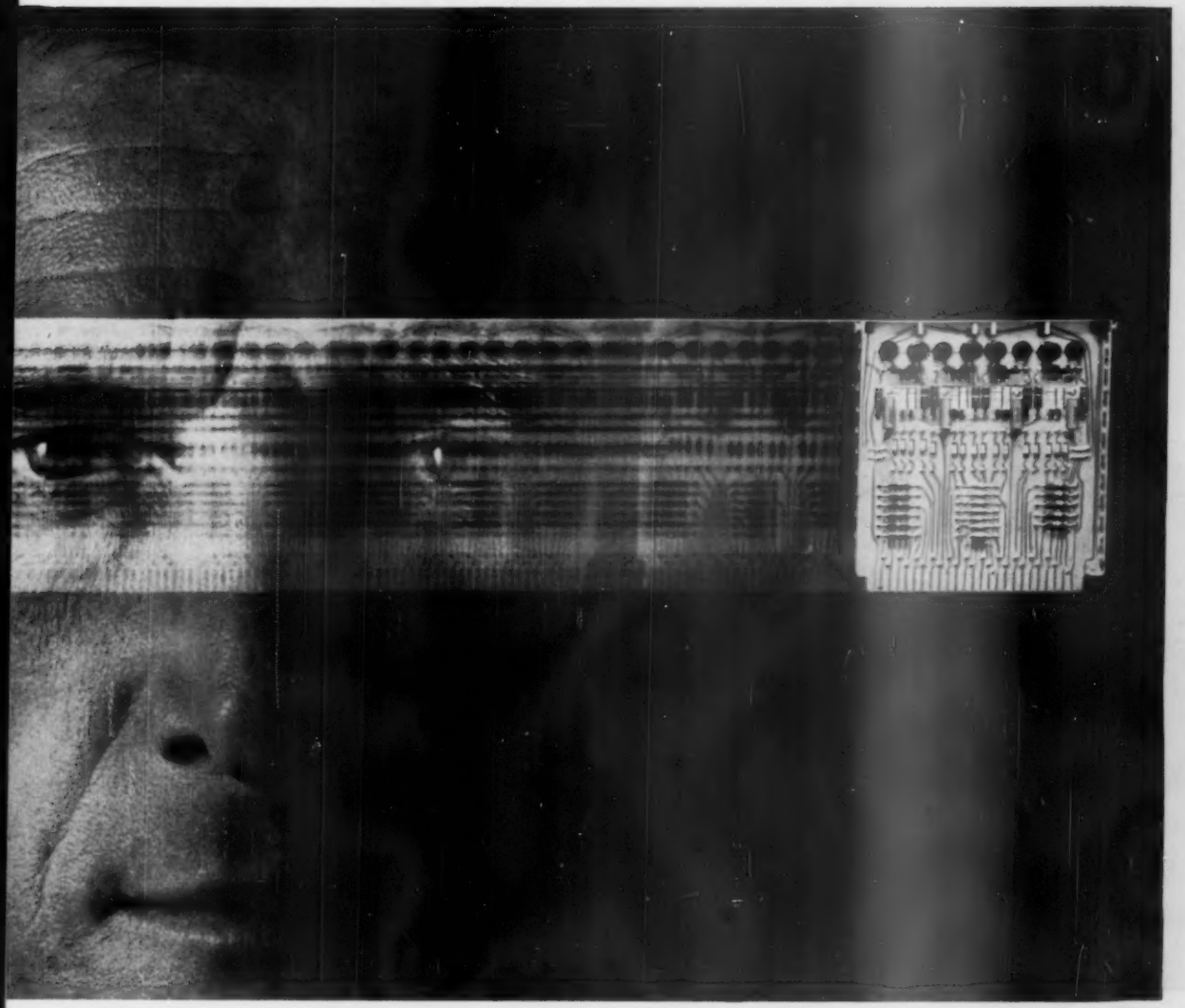

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▶ **Computer Designed by Computer**—Entire logic network of the digital computer produced by Western Electric for Nike Zeus anti-ICBM target tracking tests on Ascension Island was built from wiring diagrams, assembly information and parts lists produced by a specially programed general purpose digital computer. The technique requires less than 25 min. per subassembly to produce manufacturing information that formerly required four man-weeks of manual effort. The computer-produced manufacturing data also can be used to program an automatic wiring machine to perform actual assembly, although present hardware was produced by conventional assembly techniques. The procedure used is called Bell Laboratories Automatic Design Systems, or BLADES for short.

▶ **Airline Interest Grows in Tropo Scatter**—Significant increase in VHF air-ground communications range obtained from experimental tropo scatter installations is spurring airline interest in using this technique, particularly for transocean operations using standard airborne VHF receiver and moderate power ground transmitter atop Mt. Washington in New Hampshire. Aeronautical Radio, Inc., has achieved ranges up to 558 stat. mi. with an aircraft at 27,000-ft. altitude—200 mi. beyond the range of conventional VHF. Installation has consistently achieved ranges of nearly 400 mi. at altitudes down to less than 15,000 ft. Even greater range is expected when present 200-w. transmitter is replaced with 1,000-w. equipment this month.

▶ **Radar Resistant Suit Developed**—Air Research and Development Command is completing tests on a radiation-resistant suit developed to protect maintenance personnel from internal injury while performing emergency repairs in the presence of high-power radar beams. The new clothing, developed by engineers at the Wright Air Development Division, consists of four layers: an inner cotton liner, two layers of silverized cloth to reflect radiation, and an outer neoprene-coated nylon coverall with attached mittens. Trigger-finger mittens permit operator to manipulate small tools during repairs.

▶ **AIEE to Form Technical Groups**—American Institute of Electrical Engineers has announced plans to encourage formation of the Institute Technical Groups (ITGs), patterned after the Institute of Radio Engineers' Professional Groups. Each ITG will be allowed to hold special technical conferences and issue its own publications, also in the pattern of the IRE Professional Groups. Observers speculate that the AIEE move will result in formation of many ITGs and a further growth in the number of technical conventions and symposia (AW Nov. 21, 1960, p. 73).

▶ **Lockheed Sets Up Telephone Network**—Lockheed employes in any one of the company's 65 offices and facilities around the nation can now dial directly any one of nearly 22,000 telephones in any other office or plant, using new Lockheed line network leased from American Telephone & Telegraph Co. The integrated network, including four automatic switching centers, is expected to speed communications and save the company a quarter of a million dollars annually over previous private leased wires and ordinary long-distance phone charges. Network also can be used to transmit data between computers at the company's four main data processing centers.

▶ **Rectifier Selection Made Easy**—Two wall-charts for design engineers to assist in selection of optimum silicon and germanium rectifiers are now available from General Electric. Chart ECG-545 covers rectifier selection, while chart ECG-546 shows characteristics of common rectifier circuits. Copies may be obtained by writing General Electric, West Genesee St., Auburn, N. Y.

▶ **Signed on the Dotted Line**—Major contract awards recently announced by avionics manufacturers include:

• **American Optical Co.**, Southbridge, Mass., will conduct research aimed at improving quality of fused fiber optics face plates and developing better manufacturing techniques, under a $103,627 contract awarded by Air Force.

• **Collins Radio Co.**, Cedar Rapids, $846,661 contract for FD-105 integrated flight systems for use on Army aircraft. Army designation for the equipment is AN/ASN-33.

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Belgians, Dutch Merge Pilot Training

By Cecil Brownlow

Brussels—Belgium, beset by economic strife and the loss of key Congo facilities, is merging its air force pilot training program with that of The Netherlands. The West German air force, with largely common equipment, may meld its activities into the program at a later date.

The joint project, in which Belgium will give Dutch pilots their basic training and Holland will assume responsibility for advanced training, is designed to make maximum use of the cramped airspace available to the two countries, as well as to save money.

Possible German entry into the program is still being negotiated among representatives of the three nations involved. Points under discussion include Germany's own tight airspace and related problems, its nearness to Soviet satellite borders and the exact role it would play in such a tripartite operation.

Taken alone, however, such discussions between two small nations on the one hand and a former conqueror on the other, mark another step towards a closer partnership between the national forces within the North Atlantic Treaty Organization. As in the case of the European production program for the Lockheed F-104G, economic considerations can sometimes do much to break down emotional barriers which might exist.

Trainer Versions

Another possible material advantage to the two Benelux nations is that Germany will have on hand 30 two-seater trainer versions of the F-104. While the Belgian air force is scheduled to receive a total of 100 F-104Gs and the Dutch 120, neither has ordered the trainer version.

Col. Yvan Dumonceau de Bergendael, Belgian air force deputy chief of staff for operations, says lack of such trainers should present no immediate problems since initial F-104G recruits will be jet veterans, each with a minimum of 66 hr. on the Republic F-84F. He adds, however:

"By 1962, we may have to begin looking for a transition trainer. Pilots coming through in the latter phases with 600 hr. will be hard to find, and, eventually, we will have to replace the veterans with new, young pilots."

A training agreement with West Germany could preclude the necessity of new equipment orders by Belgium and Holland to fill this gap.

The air force hopes to receive its first F-104G, which will be produced under license by the Societe Anonyme Belge de Constructions Aeronautiques (SABCA) and Avions Fairey, by late 1962; the 100th and final one by the latter part of 1964 or early 1965.

Loss of the Belgian Congo last summer not only dealt a series of crippling economic blows, it also meant the loss of the major military installation of Kamina in Katanga Province from which all air force advanced training had been conducted since 1953.

T-6 Replaced

At the time, 16 advanced students were at Kamina, and 40 Fouga Magister jet trainers purchased from France were being phased in to replace the aging North American T-6s that had been used until that time.

When it became obvious that, under African and United Nations pressure Belgium would have to abandon Kamina, students and Magisters were trundled to Europe, with the six French-speaking students moving to France to complete their syllabus and the 10 Flemish-speaking trainees going to The Netherlands.

The Magisters were relocated at Brustem air base near St. Trond, east of Brussels, site of the advanced training school before its transfer to Kamina. Thought was given for a time to the re-establishment of Brustem as an advanced training school. This was soon replaced by the idea of cooperating with Holland and possibly Germany.

Under the new plan, the Magisters will be used in basic training, and Belgian students are scheduled to begin courses at Brustem early this year, with Dutch trainees phasing in approximately six months later after the program is well under way and most of the rough spots eliminated.

Integrated advanced training program by the Dutch probably will begin in early 1962 if present plans remain.

Belgians will provide the Dutch stu-

TWO AVRO CF-100 Mk. 5 fighters of Belgium's lone all-weather wing lineup on the runway prior to takeoff from Beauvechain air base.

FOUGA MAGISTER jet trainers of the Belgian air force will be used for the instruction of both Belgian and Dutch cadets under the cooperative program now being evolved.

dents with approximately 150 hr. of basic flight training on the Magister, while the Dutch will carry their Belgian exchange trainees through advanced training on the Lockheed T-33 jet trainer and on through the operational training phase which, for the present, will be conducted on the Republic F-84F.

Augmented Force

As the exchange program moves into full swing, the Dutch will send a number of their Fouga Magisters to Belgium to augment the latter's basic trainer force.

Belgium, in turn, will hand over a quantity of T-33s and F-84Fs to the Dutch to supplement their equipment. Instructors for the respective aircraft also will be exchanged.

If West Germany enters the picture, present arrangements obviously must be shifted, and the German air force, with its relatively large number of trainers and excellent facilities at Furstenfeldbruck air base, could be assigned the T-33 phase under any tripartite agreement which might be reached. (AW Jan. 9, p. 65).

Germany also could assume responsibility for the primary training of the three nations, but it is felt that each country will want to retain this particular phase as a national function since it is here that the weeding-out process is at its greatest.

Although the numbers of additional students and flying activity that must be absorbed by each country will be relatively small, they will place additional burdens upon already overcrowded airway systems.

Belgian plans, for example, to rebuild Brustem into a major training site could cause problems for both civil and military aviation authorities. Col. Dumonceau de Bergendael, who flew with the Royal Air Force after Belgium's fall in World War II, says:

"In Belgium and Holland, if you look at an airways map, you will see that there is very little airspace left, and when Brustem is in full swing, we will have to make some arrangements with the civil aviation authorities to get more space for our use."

The airways map shows that two major airways—one to Cologne and one to Luxembourg—fall within the operational vicinity of Brustem.

Training interruptions, site problems and other compromises triggered by the Congo crisis present another roadblock to the slow rebuilding of an effective air force that was begun shortly after Belgium's World War II liberation with a smattering of British Spitfires and Mosquitoes.

Dissolution of the Belgian armed forces after the German occupation and their subsequent revival did have one

STAMPE SV-4B biplane remains as the standard primary trainer for the Belgian air force.

salutary effect, however, in the minds of Belgian air force officials. After the effectiveness of airpower had been amply demonstrated by both sides during the war, the Belgian government recognized the air force, traditionally a wing of the Army, as a separate entity as it began to rebuild in 1946.

With a total of approximately 23,000 men—about 1,000 of them pilots—the air force's present operational strength represents aircraft of three nations and breaks down into:

- **One wing of Avro CF-100** Mk. 5 all-weather fighters from Canada.
- **One wing of Hawker Hunter** fighters from Great Britain trimmed from two wings at the beginning of 1960.
- **Two wings of F-84F** fighter-bombers from the U.S.
- **One squadron** of RF-85F reconnaissance aircraft.
- **One transport wing,** including two squadrons of Fairchild C-119s, plus a smattering of Douglas DC-6s and DC-4s and DC-3s and Hunting Pembrokes.

First of these obsolescing aircraft to go as the F-104G begins to appear will be the F-84F, and air force officials hope that most of them can be retired by late 1963.

Since the Congo loss, all these operational units have been clustered within metropolitan Belgium, adding further to the airways congestion. Within the NATO framework, all units fall under the command structure of the Second Allied Tactical Air Force.

In rebuilding its force, Belgium, as in the case of West Germany, has been forced to rely upon both commissioned and noncommissioned pilots, and even subdivisions of these categories. However, now that the force structure has been substantially attained, the air force—in another parallel move with West Germany—hopes in the future to have an all-officer pilot cadre.

Col. Dumonceau de Bergendael says no further noncommissioned pilot candidates will be accepted after the next class is processed early this year. "We can't afford it," he explains. "The aircraft are becoming too expensive to put them into the hands of pilots who can't qualify as officers."

At present, the pilot force is almost evenly divided between noncoms and officers. The noncommissioned pilots, however, are being shifted as quickly as possible from combat units and into transport sections. Approximately 100 cadets a year in all categories enter the program. Of these, between 30 and 40 will win their wings.

Under the present system of selection, pilot applicants can qualify as either a "career" or "auxiliary" officer candidate or as a noncommissioned candidate in one of the two categories. Age limits for both officer and noncommissioned candidates are 17-to-25, with the usual educational standards determining the category into which a particular student will fall. Officer candidates must have the equivalent of a junior college education in the U.S.; noncommissioned candidates that of a high school degree.

Training Period

Auxiliary officer and noncommissioned trainees must enlist for a minimum of six or a maximum of 12 years and, with a minimum of officer's training as such, normally win their wings within 15-to-17 months. Advancement through the lower grades is also relatively swift.

"We're primarily interested in using these people strictly as pilots and as soon as possible," one staff officer explains, "and not necessarily as officers in the usual sense."

Career officers are either graduates of the Ecole Royale Militaire in Brussels—in which a student has the choice of a three-year academic degree or a five-year engineering course—or he can attend a prolonged officer's training school after he is in active service.

An auxiliary officer can transfer to career status by attending the training

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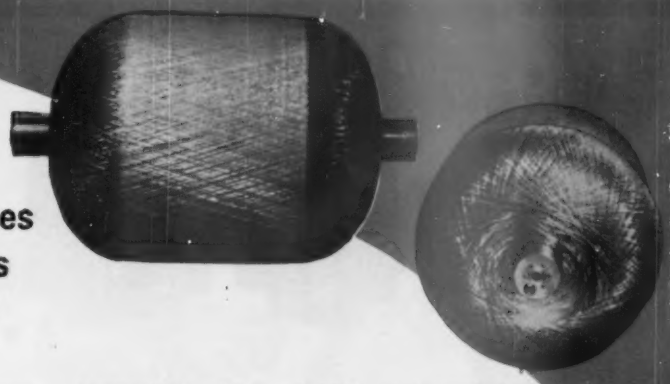

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This capability is a new high point of TAPCO's seven years of experience in reinforced plastics. Programs for the missile industry include the Pershing TEL blast deflector, plastic nozzle components for all stages and all motors under development for an advanced missile program, the booster nozzle and internal insulation for Super Talos, and plastic components for the Polaris second-stage nozzle and the Sidewinder booster motor.

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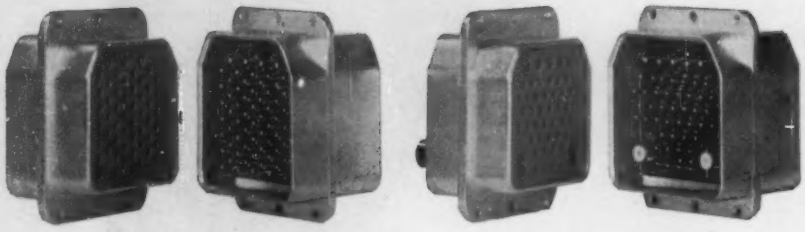
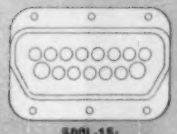


NOW FOR THE FIRST TIME you can have a rack and panel connector with contacts made in accordance with MIL-C-26636... an exclusive CEC feature. And they are available in six configurations... Die-cast aluminum shells in accordance with MIL-QQ-A-591A and insulator blocks of high-strength glass-filled diallyl phthalate per MIL-M-19833. Check these configurations with your requirements:



500L-15:
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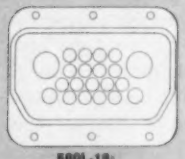

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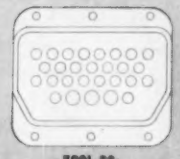
coaxial contacts.



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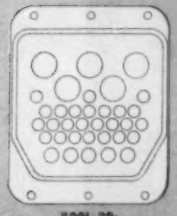

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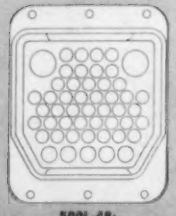
5 size 16 contacts,
5 standard RG58/U
coaxial contacts.



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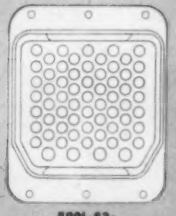

500L-63:
59 size 20 contacts,
4 size 16 contacts.

For more information, write for Bulletin CEC 4006-X9

Electro Mechanical Instrument Division CEC

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school once he has won his wings provided there is an opening. His permanent date of rank, however, suffers and, in the long run, he will generally lag behind a colleague who entered the service on a career basis.

Another advantage of the career candidate is that once through training school, he will almost certainly be retained in the Air Force as an officer in some capacity. An auxiliary candidate, on the other hand, is recruited as a pilot, nothing more. If he washes out of flight school, he is automatically discharged, and his service career ends.

PRODUCTION BRIEFING

Nike-Zeus target track radar has begun its test program on Ascension Island in the South Atlantic, near the impact area of ICBM test vehicles fired from Cape Canaveral, Fla.

Corps of Engineers Ballistic Missile Construction Office will receive bids for a contract to build the Minuteman ICBM base complex around Malmstrom AFB, Mont., Feb. 7.

Federal Aviation Agency has contracted with Boeing Airplane Co. for a 720 medium-range transport for use in its training program for safety inspectors. The FAA Boeing 720 will be delivered in May.

Marquardt Corp. has made initial delivery of ramjet engines for the Army's supersonic NA-273 target missile to North American Aviation's Columbus Division. Test firings of the NA-273 are scheduled to get under way in March with the first two engines fired at the White Sands test center.

Aerojet-General has signed a licensing and technical assistance agreement with Societe Europenne de Teleguidage (SETEL), Paris, for production of Hawk missile motors.

Raytheon Co. has been awarded a $2.5 million contract for continued work on the Polaris missile program. Under the contract, Raytheon will continue to provide industrial support to MIT in design and development of the Mark II Polaris inertial guidance system.

Bell Aerosystems Co. will conduct an 18-week flight test program of an automatic ground control landing system under terms of a $73,045 contract from the U. S. Navy Bureau of Weapons. The system, intended for use with drone aircraft, will be tested with an F9F-6K target drone. It is an adaptation of the AN/SPN 10 system developed by Bell for automatic landings aboard carriers.

WHO'S WHERE

(Continued from page 23)

Honors and Elections

Thomas F. Dixon, vice president-research and engineering, Rocketdyne Division of North American Aviation, Inc.; **John Jeffries Award—Capt. Joseph W. Kittinger, Jr.,** USAF, Project Engineer, Life Support Systems Laboratory; **Robert M. Losey Award—Dr. Thomas F. Malone,** director of research for Travelers Insurance Companies; **Sylvanus Albert Reed Award—John V. Becker,** chief of the Aero-Physics Division of NASA's Langley Research Center; **Lawrence Sperry Award—Robert B. Howell,** supervisor of Advance Control and Guidance Dynamics for Lockheed Aircraft Corp.'s Missiles and Space Division; **Minta Martin National Student Awards—Roddam Narasimha,** Doctorate Division, **David A. Pirie** and **George W. Stone,** Masters Division, and **Herbert Fox,** Undergraduate Division. Named IAS Fellows: **Eduard Amstutz,** president, Swiss Federal Laboratories; **Seymour M. Bogdonoff,** Princeton University; **Handel Davies,** deputy director, Royal Aircraft Establishment; **Alexander H. Flax,** USAF; **Brig. Gen. Don Flickinger,** USAF (MC); **Frederic C. Haus,** Universities of Ghent and Liege; **Willis M. Hawkins,** Lockheed Missiles and Space Division; **Abraham Hyatt,** NASA; **John F. Parsons,** NASA's Ames Research Center; **Lt. Gen. B. A. Schriever,** USAF; **B. S. Shenstone,** British European Airways; **Elmer P. Wheaton,** Douglas Aircraft Co.'s Missiles and Space Systems.

Gen. Thomas D. White, Chief of Staff, USAF, has been awarded the Frank M. Hawks Memorial Award by Air Service Post 501 for his outstanding contribution to military astronautics.

Changes

Dr. Warren N. Arnquist, assistant to the director of advanced research, Douglas Aircraft Company, Inc., Santa Monica, Calif.

Dr. Milton J. Allen, manager, Chemical Research Department, Electro-Optical Systems, Inc., Pasadena, Calif.

W. W. Rutledge, division operations manager, Boeing Industrial Products Division, Seattle, Wash.

George R. Tallent, program manager, Motorola-Autonetics Minuteman reliability program, Motorola Semiconductor Products, Inc., Phoenix, Ariz.

Wesley G. Kaldahl, director-special projects, Schedules Department, American Airlines, Inc.

H. F. Goelzer, manager of the newly established Plans & Programs Department of the Pomona (Calif.) Division, The Marquardt Corp.

Salvatore Xifo, European engineering representative, Norair Division of Northrop Corp., with headquarters in Paris, France.

Charles E. Rees, Jr., director of research, Actuation Research Corp., Glendale, Calif.

David B. Young, military applications engineer, General Electric Co.'s Ordnance Department, Washington, D. C.

Dr. Rudolph G. E. Hutter, chief engineer, Microwave Device Operations, Electronic Tube Division, Sylvania Electric Products, Inc., Mountain View, Calif.

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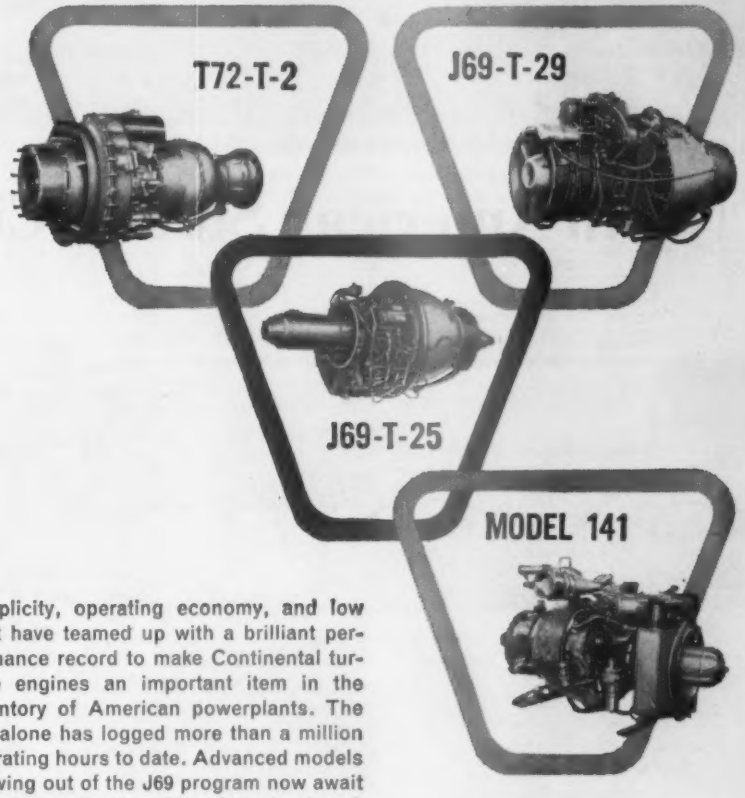

Simplicity, operating economy, and low cost have teamed up with a brilliant performance record to make Continental turbine engines an important item in the inventory of American powerplants. The J69 alone has logged more than a million operating hours to date. Advanced models growing out of the J69 program now await industry application. They include aircraft turbojets of 1,400 and 2,400 lbs. thrust, "aft-fan" turbofan engines of 2,600 and 4,000 lbs. thrust, a target-missile turbojet of 2,550 lbs. thrust, altitude thrust augmentation devices for existing turbojets, and the J69-T-35 air pump for boundary layer control. Rounding out Continental's capability in the field of aircraft propulsion is a completely new series of turboshaft and turboprop engines, including the 500-hp, 6,000-rpm 217-5A (U. S. Navy designation T72-T-2) turboshaft, which promises to find use in a wide variety of applications.

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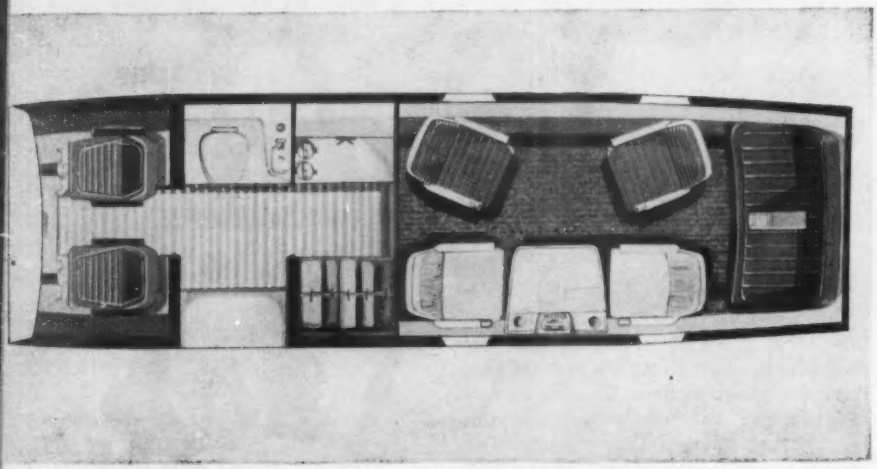
SABRELINER takes off from Los Angeles International Airport for a 500-mph. flight. The jet was designed to USAF specifications.

North American Studies Civil T-39 Market

By Russell Hawkes



PROPOSED corporate transport interior of Sabreliner would accommodate six passengers besides the crew. Price of the plane is estimated at $900,000.

Sabreliner Operating Cost Estimate*

Trip Length (naut. mi.)	300	500	700	900	1,300	1,500
Costs ($/hr.)						
Fuel @ 32 cents/gal.	122.50	103.50	95.00	89.00	82.00	80.00
Oil	1.76	1.76	1.76	1.76	1.76	1.76
Maintenance & overhaul	54.80	54.80	54.80	54.80	54.80	54.80
Subtotal/hr.	179.06	160.06	151.56	145.56	138.56	136.56
Taxes & license	1.00	1.00	1.00	1.00	1.00	1.00
Hangar & port	4.00	4.00	4.00	4.00	4.00	4.00
Total $/hr.	184.06	165.06	156.56	150.56	143.56	141.56
Flight speed (kt.)	327	348	360	367	374	376
Costs of fuel, oil, maintenance & overhaul per mile	47.6 cents	40.1 cents	37.6 cents	34.5 cents	32.2 cents	31.6 cents

* 600 hr./yr. utilization, ISA plus 25F, recommended cruise speed (depreciation, insurance, crew salaries and travel expenses not included due to extreme variations and nature of items).

Los Angeles—North American Aviation is still officially undecided on whether to offer the civilian corporate version of the USAF T-39 Sabreliner to civilian buyers.

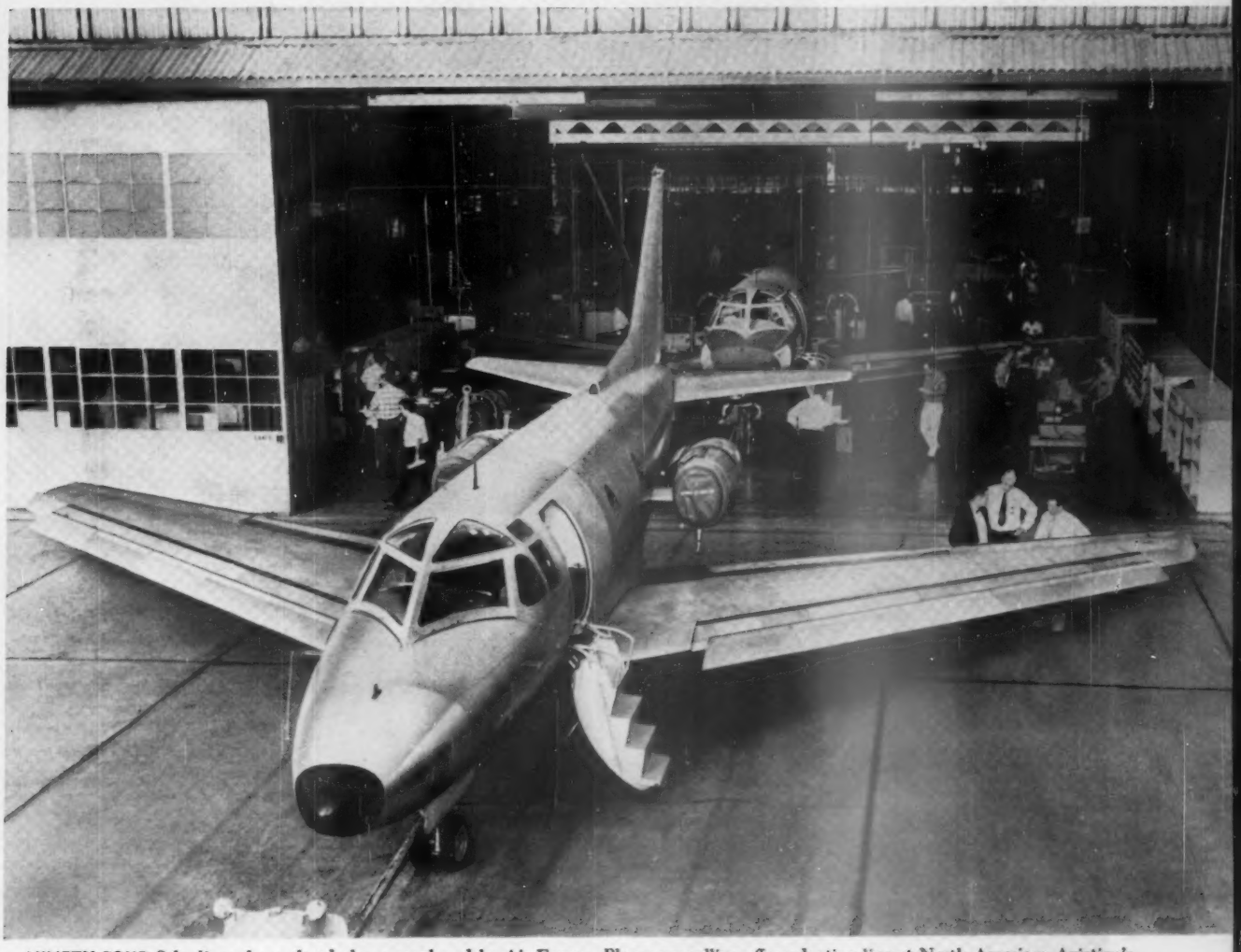
Company spokesmen say the decision to go ahead with the civilian program may be months away. A major factor in this hesitancy is the fact that NAA hopes for more military sales. The profit margin per airplane rises as military sales of the airplane pay off development costs and as experience with the design pushes the production cost curve downward. Also, there is less inventory risk in fabricating parts for a civilian version if a big military backlog is available to absorb them in the event that civilian sales fail to measure up to expectations. North American has sold 94 of the airplanes to USAF on an off-the-shelf basis and seven have been delivered. The T-39 Sabreliner was developed with company funds after USAF had expressed interest in buying such an airplane on that basis.

Development costs had to be balanced in the fixed price of the airplane or in other ways.

Officials Confident

North American officials are confident that more military sales can be expected, especially in trainer versions. Prospects for foreign military sales are also considered good. Air Force's intention to use the T-39 as a NASAR (North American search and ranging radar) navigation system trainer has aroused the interest of allied air forces

FEDERAL AVIATION AGENCY flight test program at Palmdale, Calif., on North American T-39 Sabreliner marks a major milestone in the progress of the Air Force twin-jet trainer. FAA type certification flight testing is to be completed in April.



NINETY-FOUR Sabreliners have already been purchased by Air Force. Planes are rolling off production line at North American Aviation's Los Angeles Division. Seven have been delivered, three are participating in FAA certification program.

The most proven large ballistic missiles, the Atlas (left) and Redstone (right), will launch America's Astronauts. Main-stage engines of both are by Rocketdyne.

AMERICA'S ASTRONAUTS WILL BE LAUNCHED INTO SPACE BY ROCKETDYNE ENGINES

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And this means engines built by Rocketdyne.

A Redstone engine, whose performance over a decade of development includes 62 consecutive successful flights, will loft the first manned space craft high over the Atlantic in an exploratory ballistic arc.

Then an Atlas system of five engines, proven in more than 60 development and operational flights, will send a man soaring upward more than 100 miles to circle earth for four hours during man's first orbital flight in space.

To that dramatic moment, Redstone and Atlas will carry the heritage of more than 18,500 large engine tests at Rocketdyne's Propulsion Field Laboratory.

At every level of operation—from engineering to manufacturing to cost control—Rocketdyne has pioneered new concepts. Advanced management programs, combined with vast experience and the foremost high-thrust test facilities in the nation, give Rocketdyne the capability today to meet the challenges of tomorrow.

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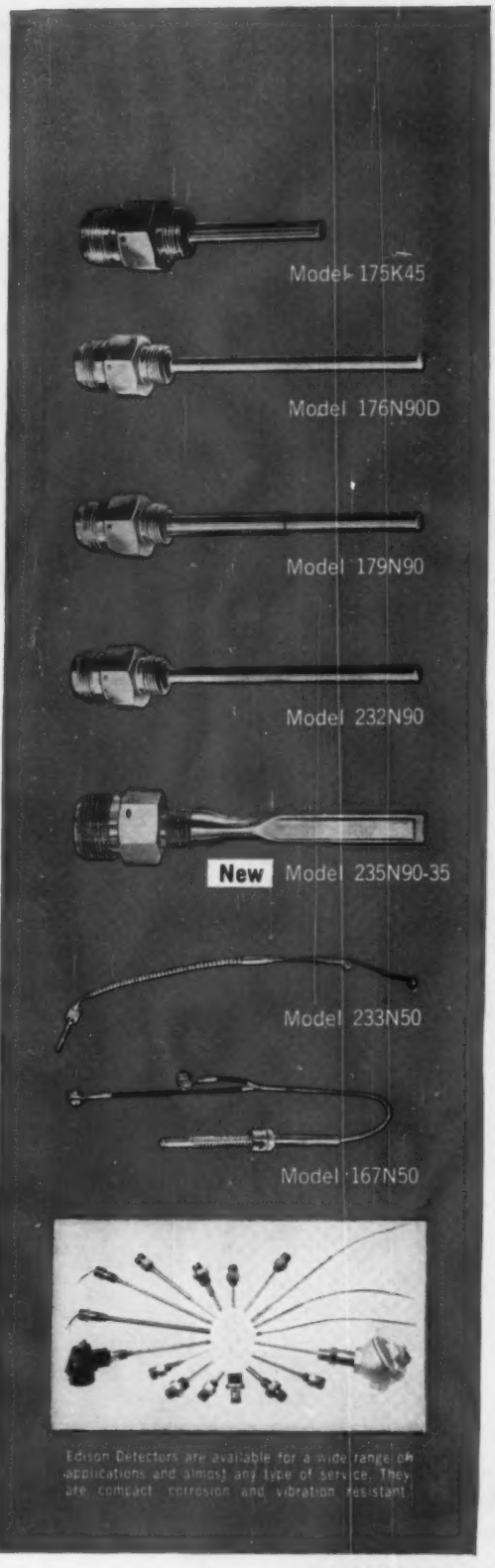
Model 175K45
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also slated to use NASAR, and North American salesmen believe they are potential customers.

The number of military sales which can be rolled up before civilian orders are taken will have a strong bearing on the price for which the airplane can be offered. Present highly tentative estimates of the price of a commercial Sabreliner are about $700,000 for a bare airplane lacking avionics or passenger accommodations. These would be custom selected and their sale would be separately negotiated. Fully equipped, the price should be about $900,000 with spares.

R. J. Pfeiffer, manager of commercial marketing for North American, estimates that about 500 companies in the United States can afford the Sabreliner and have the management structure to operate it profitably if their operations are geographically dispersed enough to make the airplane valuable.

Estimating the worth of the airplane to the buyer is somewhat more difficult than in the case of commercial transports because of the number of imponderables involved—such as the effect upon the prestige of the company and the attraction it offers to executives who would otherwise retire early or seek other jobs. Most business aircraft salesmen can recite instances in which a single flight brought enough business to pay for the airplane.

Three of the first seven Sabreliners delivered to the USAF are being used for Federal Aviation Agency type certification flight testing to be completed in early April. May 15, 1961, is the scheduled date of type certification.

Basic Advantage

The basic advantage claimed for fast corporate aircraft such as the Sabreliner is their ability to increase the productivity of management to correspond with increasing productivity created at other corporate levels by new devices and techniques. For a company that is dispersed geographically, the fast airplane extends the powers of central management into the field offices. The Sabreliner cabin is about the same size as that of a Twin-Beechcraft and can accommodate six passengers.

It can carry its maximum design payload, 1,200 lb., to a distance of almost 1,800 mi. Beyond that distance payload must be compromised for additional fuel. Economics of the Sabreliner are figured on the assumption that 75% of the airplane's flights will be to distances between 200 mi. and 800 mi. Company operations analysts estimate four seats or less will be filled on 80% of the flights.

As part of its campaign to build interest among potential buyers, North American Aviation is mailing out sample flight plans demonstrating the abil-

is kept on the alert with the help of an Eastern pressurizer dehydrator system. This compact unit feeds a flow of controlled, dry air to the wave guide of the powerful acquisition radar — at pressures higher than the atmosphere, so that the ambient can't sift in through leaks. As a result, moisture can't condense on high-voltage elements; dangerous arc-overs are eliminated. The dehydrating pressurization pack is completely self-contained, circulates air through alternate, self regenerating capsules of silica gel which need never be replaced. For additional information, write for Bulletin 370.

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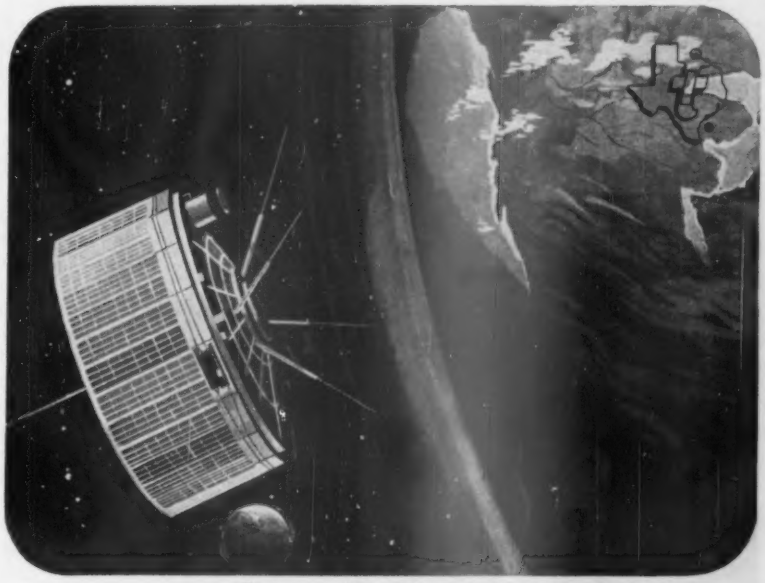

TI electronic flight control in Douglas Aircraft's Delta launch vehicle helped orbit the NASA weather satellite TIROS II.

TI FLIGHT CONTROLS IN SPACE EXPLORATION

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7100 Series—Eye-wash sends pressure-controlled streams from chrome plated brass heads. Acid-resisting enameled iron bowl.

7700 Series—Eye/face-wash simultaneously sprays water from perforated copper ring and fountain heads. Stainless steel bowl.

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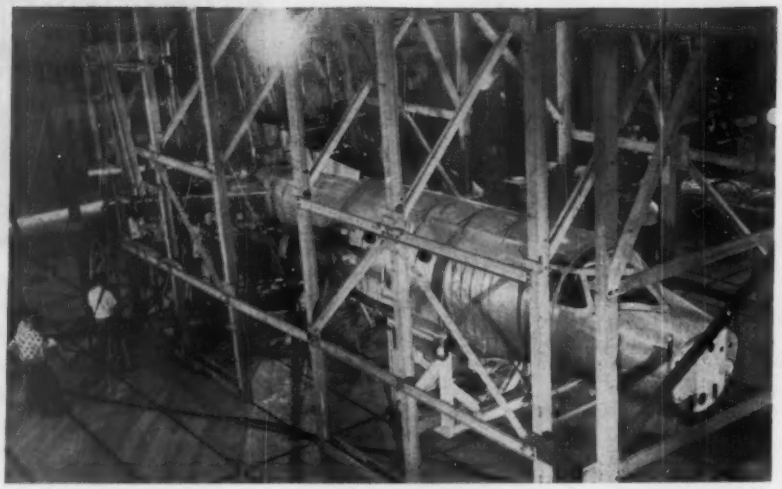

SABRELINER, shown above, passed stress and strain tests in excess of specifications.

ity of the Sabreliner to enable a management team to transact business in three cities as widely separated as New York, Minneapolis, and Shreveport, La., in the course of a single day.

Pfeiffer points out that arithmetical arguments are frequently useless in selling business aircraft. The sales staff of one large company which owns an older business airplane rejects anything faster because the length of their sales pitch coincides exactly with the time needed for the older airplane to reach a certain Caribbean resort.

At present there are no plans to extend the range of the Sabreliner with external fuel tanks, though this could probably be done. Total fuel capacity is 1,056 gal. with 893 gal. in the wing tanks and 163 gal. in an auxiliary fuel cell aft of the rear cabin pressure bulkhead.

Usefulness of the Sabreliner is not limited by excessive runway requirements. At sea level on a standard day, takeoff roll is reported to be 2,500 ft. and landing roll 1,850 ft. North American officials say the airplane touches down at 110 mph. and is flown at 118 mph. in the approach. Like some North American fighters, the Sabreliner has aerodynamically actuated leading edge slats to improve low speed performance. Stall speed at landing weight of 11,375 lb. is 93 mph.

The Sabreliner will have a cabin pressurization system for passenger comfort. The maximum working differential of 8.8 psi. between cabin pressure and ambient pressure is equivalent to a cabin altitude of 8,000 ft. at flight altitude of 45,000 ft. The structure-limited ultimate pressure differential is 18.35 psi. The pressurization system supplies bleed air to the cabin directly from the final compressor stage of each engine. Cabin pressure is regulated by a pneumatic control system which senses and responds to ambient pressure. The pilot can use the pressurization system controller to select a cabin altitude from 1,000 ft. below sea level to 10,000 ft. and a rate of change between 50 fpm. and 2,000 fpm. A refrigeration unit and water separator cool part of the bleed air in preparation for mixing with uncooled air to get exactly the preset temperature. To prevent the cabin from overheating if the refrigerator unit fails, a ram air source can supply cool air. An electric blower in the ram air inlet provides cool air for the cabin when the airplane is on the ground. If the system is turned on and the engines are not operating, the blower is automatically started by the landing gear load switch.

The passenger entrance door of the Sabreliner is a plug-type panel hinged at the bottom with integral steps on the inside of it. The doorway is 47-in. high and 28-in. wide.

Cessna Dollar Volume Reaches New High

Wichita, Kan.—Cessna Airplane Co. in Calendar 1960 delivered 3,721 airplanes, exceeding the combined total of all other U. S. business aircraft manufacturers by 123 units, according to the company's marketing division manager, Frank Martin.

Cessna's commercial aircraft dollar volume went to an all-time high for the company, totaling $59.1 million, a 23% increase over Calendar 1959, he noted.

Breakdown in unit sales for last year includes these deliveries: 354 Model 150s, 501 Model 175s and Skylarks, 283 Model 180s, 667 Model 182s and Skylanes, and 290 Model 310 light twins. The high-wing retractable landing gear Model 210 accounted for 610 units in the first year since its

introduction. The 172 and Skyhawk series was the most popular of all Cessna models last year, accounting for 1,015 unit deliveries.

Since introduction of Cessna's 1961 line last October (AW Oct. 31, 1960, p. 31), it has delivered 1,130 units at a total factory billing of $15.7 million compared with 1,058 units valued at $12.4 million at the same time a year ago, Martin stated.

Finance Firm Enters Plane Leasing Field

New York—An old line commercial financing firm, James Talcott, Inc., has entered the aircraft leasing business and expects to lease units at a rate of 100 planes and helicopters a year.

Talcott Leasing Corp., a subsidiary, is headed by Vice President John Duncan who said the firm entered the airplane business as a natural extension of its longtime leasing activities in the field of heavy equipment and machine tools.

Included in 40 leases so far completed are a Beech D50 to Corporation Services, Inc., a Greensboro, N. C., real estate firm; Craver Industries, Charleston, S. C., which flies a Cessna 172, and Puerto Rico Helicopters, Inc., operators of a Hiller 12E to shuttle passengers between International Airport at Isla Verde to San Juan hotels.

Duncan said Talcott Leasing buys the airplanes outright from a dealer or the factory, usually after determining the potential customer's needs and preferred price range. Leases are made on a 60-month basis on either straight line, accelerated or sum of the digits contracts.

For instance, a Piper Custom Comanche, which costs about $21,000 can be leased for 60 months on a straight line basis for $26,000; payments would be $433.33 a month. After expiration of the lease, the buyer would have an option of outright purchase for $1,200 or continuing to use the plane for a yearly rental of $400.

Lease charges drop to $4,500 by adopting the sum of the digits type of contract, Duncan pointed out. Using this method, payments for the first 12 months are $680; second 12, $544; third 12, $408; fourth 12, $272; next 11 months, $138, and the last month $134.

In the twin engine field, a Cessna 310D, in the $70,000 price class, would cost a lessee $1,516.66 a month on a straight line lease; lease charges on the 60-month period would be $21,000. The plane could be bought at expiration for $4,200 or rented for $1,400 a year.

James Talcott, Inc., was founded in 1854 as a textile factoring firm and now does an annual volume in receivables of $1.1 billion.

PROBLEMATICAL RECREATIONS 52

Three regiments move north as follows: B is 20 miles east of A; C is 20 miles south of B, and each marches 20 miles between the hours of 5 A.M. and 3 P.M. A horseman with a message from C starts at 5 A.M. and rides north till he overtakes B, then sets a straight course for the point at which he calculates to overtake A, then sets a straight course for the point at which he will again overtake B, then rides south to the point from which B started, reaching that point at the same time as C, namely 3 P.M. What uniform rate of travel enabled the messenger to do this? (This is an old problem and was very hard on the horse.)

—*American Mathematical Monthly*

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ANSWER TO LAST WEEK'S PROBLEM: The solution depends on maximizing $y = x^{1/x}$. The value of x to maximize y is e. Thus $e^{1/e} > \pi^{1/\pi}$. If both sides are raised to the πe power one gets $e^{\pi} > \pi^{e}$.

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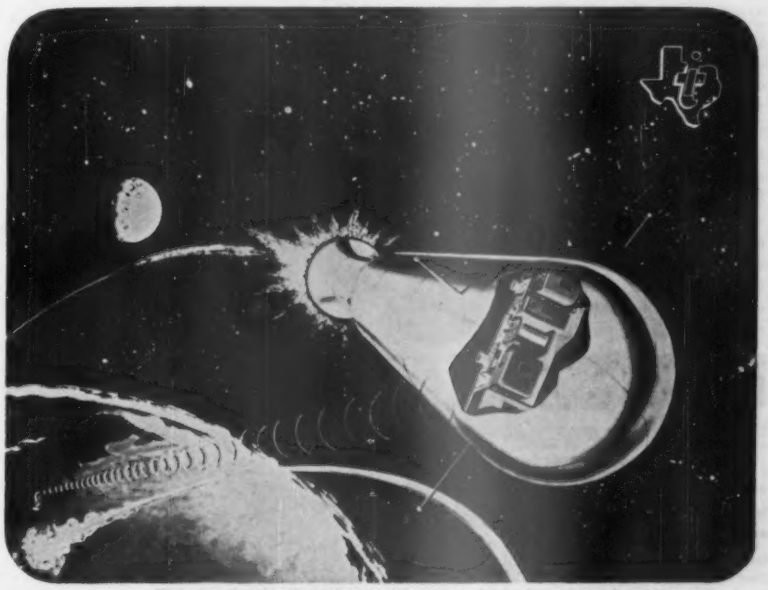

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Helicopter Operators Seek More Participation in FAA Rulemaking

By Herbert J. Coleman

Haddonfield, N. J.—U. S. helicopter operators are adding their voices to others in the rotary wing field for more participation in Federal Aviation Agency rulemaking, in view of FAA plans to write a new regulation governing their activities.

The operators, attending the annual meeting of the Helicopter Assn. of America here, expressed some concern at future regulation, with a few operators resisting any regulation at all.

Prime concern, though, is in the external loading practices now carried out, often "illegally," by various operators who have developed in-house gadgets to contain loads, carry them and fasten racks to the fuselage.

Question of legality was raised by James W. Gavin, of Mercury Helicopter Service, Inc., who said there is no fixed rule on hauling or fastening loads.

He added: "However, when one works for a federal agency on contract, everyone turns his head the other way."

As examples of what Gavin said were illegal external loads are hose trays and helipumpers, both widely used in contract work for the U. S. Forest Service in fighting forest fires.

Gavin urged FAA standardization of slings, pods, etc., for safer operations and to allow the helicopters to fly over metropolitan areas with external loads. He stressed that he could not believe that FAA "will continue to let the operators go ahead with their own designs of slings and racks."

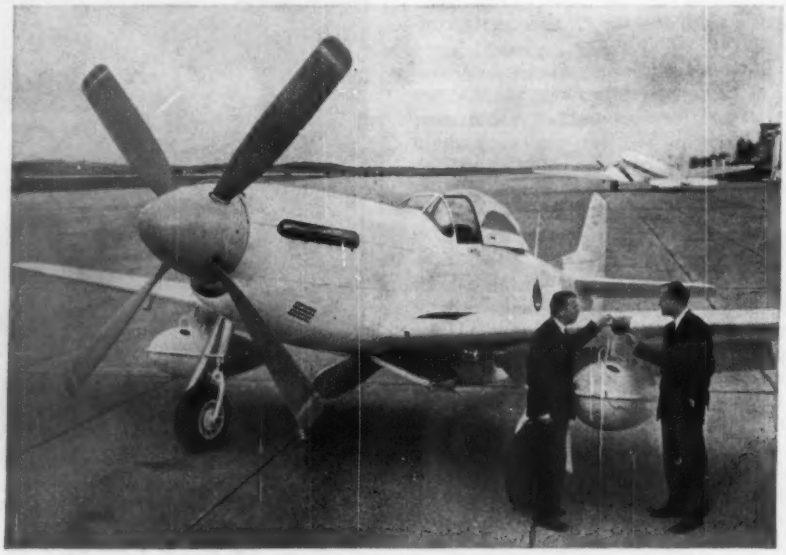
This comment brought a suggestion from Hal Connors, of Helicopter Airlift, new association president, that the association form a committee to meet with FAA and with an existing committee from Aerospace Industries Assn. to formulate suggestions.

One operator opposed to further regulation was Link Luckett, of Hill-I-Copters, Inc., an Alaskan firm, who retorted:

"What we are saying is that we have been robbing the bank for 10 years and now we want to make it legal. We need to eliminate the regs, rather than write up more controls. Next thing, the FAA will be regulating the top of a crane on the theory that it is moving a sling through the air."

However, C. A. Commander, FAA assistant chief of safety regulation, Bureau of Flight Standards, said sling hoists are considered in the special operation section of the Civil Air Regulation Part 8, governing helicopters, and industry reaction will be sought.

Commander spoke after Connors attacked current FAA regulations on



Lear Flies Converted P-51

World War II North American P-51 has been converted into a two-seat executive aircraft for use by Lear, Inc., executives in Europe. Modifications on aircraft, reportedly the first corporate P-51 in Europe, were made in Tel Aviv. Aircraft is shown at Geneva's Cointrin Airport upon arrival from Israel with W. P. Lear, Jr., Lear vice president and director-European operations, and Robert J. Clark, vice president-North American Aviation SA.

helicopters as resulting in "over-safe, impractical, un-safe regulation," suggesting a school for FAA rulemakers to actually observe operations, particularly in heavily congested areas such as Chicago, where Helicopter Airlift operates. He charged that FAA has "few qualified flight examiners" and that those have "little actual helicopter experience."

Commander countered that rules only follow extensive study and often are initiated by the industry in written proposals. A new Part 47 now is in the works and FAA has requested data and reaction from the industry. Part 47 aims at:

- **Clearer definitions** on helicopter vs. fixed-wing operations, such as data on IFR-VFR needs, operating minimums and heliport approach and departure areas.
- **Possibility** of a similar suggestion for aerial applicators (AW Jan. 9, p. 115). That would call for an operating certificate, use of a training manual, operating rules, etc., to allow the operators to work under an FAA Part, rather than waivers.
- **Certification of twin-turbine** helicopters on the basis of one-engine-out operations, and requirements which must be met by running the helicopter on single-engine maximum continuous power, probably for at least 30 min. at takeoff power.
- **Congested area** flight operations for general helicopter guidance.

On the manufacturer level, Commander said FAA is interested in en route engine performance, cockpit panel arrangements and stability requirements. Notices will be mailed in the near future.

Two questions never got an answer. Gavin asked why FAA did not have regional hearings on rulemaking, rather than one general meeting, thus making it difficult for all interested parties to attend. Hersey W. Young, Jr., of Helicopters, Inc., asked how FAA could determine a minimum operating altitude for helicopters operating over non-congested areas.

On helicopter insurance rates, now considered inordinately high, Young suggested a group plan, in which operators form their own insurance firm on lines set down by several trucking firms who have done this. Commenting on this, J. C. Weadock, of Chesapeake & Potomac Airways, a former association president, said:

"The group idea to obtain a lower rate is basically sound, but the insurance companies also have problems with helicopters. Until we raise our standards in pilots, maintenance and operations personnel, we can't give them anything but a bad risk. When we raise our standards, the rates will go down."

This view apparently was aimed at a number of small operators whose safety practices are best described as marginal, mostly to cut costs. They were not singled out for comment.

Helicopter business has reached a $50-million yearly volume, according to L. Welch Pogue, former Civil Aeronautics Board chairman, now a partner in the Washington, D. C., law firm of Pogue & Neal. This figure, he emphasized, does not include military operations or expenditures, nor the operations of the three scheduled lines serving New York, Chicago and Los Angeles.

Connors succeeded R. L. Suggs, Petroleum Helicopters, as new president. New vice presidents are Hersey Young, and J. C. Weadock. Treasurer is Peter Wright, Keystone Helicopter Corp.

Bell Aims Helicopter Sales Push Into Dominant Fixed-Wing Field

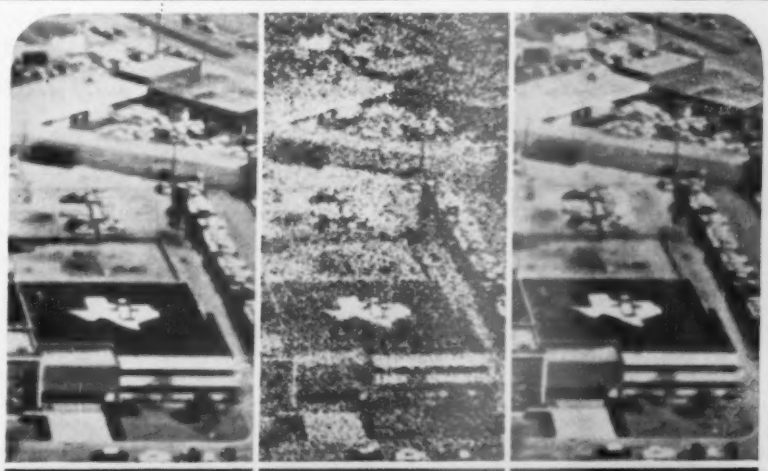
Details of an aggressive merchandising and sales campaign aimed at boosting rotary-wing aircraft business by some 50% this year were revealed by Bell Helicopter Co.'s commercial sales manager Dwane K. Jose to operators gathered at the Helicopter Assn. of America's annual meeting.

The program is designed to develop a sales breakthrough for helicopters to corporate and private users similar to that experienced by the fixed-wing business airplane since World War II, although Bell does not expect that it will approach this market in number of helicopter units.

Basis for the program is to develop what Bell commercial sales personnel feels is a large potential in the business flying market that has not been exploited to nearly the extent possible, leaving this field much the exclusive domain of the fixed-wing manufacturers.

Rotary-wing aircraft manufacturers hitherto have taken the natural path of least resistance in sales by emphasizing their effort to the industrial user of the machine—the charter operator serving oil exploration, geological survey, fire fighting and a score of other such missions. As a result, sales balance in the past five years, for example, shows that the charter operators have accounted for approximately 50% of the market.

Jose believes that sales can be increased considerably by developing a new program aimed at a large build-up in executive transport use while con-



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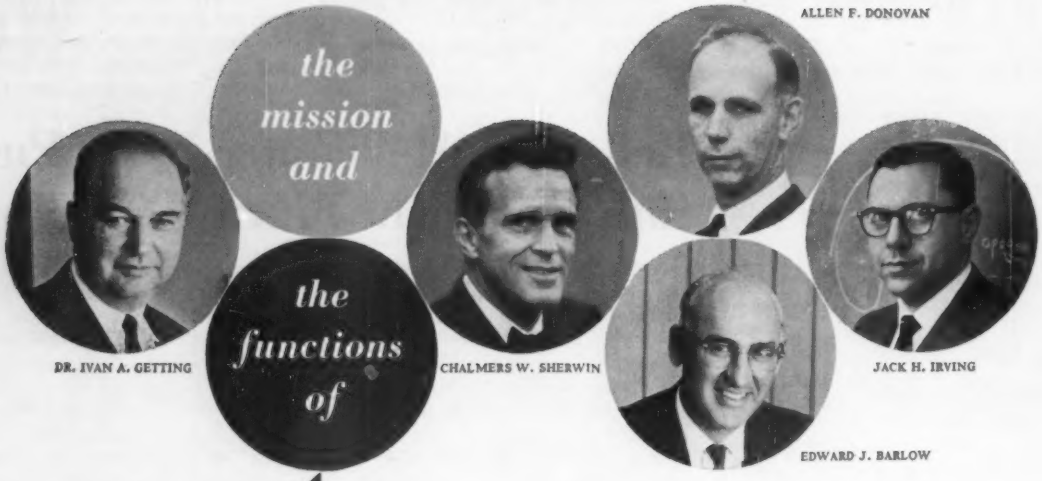

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DISTRIBUTION of Bell Helicopter commercial sales from 1955-59 shows large percentage provided by charter operator market because of sales emphasis in this field.

currently providing a program for charter operators that will give them increased factory support in merchandising know-how and demonstration support.

Three-Phase Plan

Bell's merchandising plan this year will be divided into three main phases:

• **Phase 1** begins with introduction of the new models to the operators, with first public showing of hardware at the Helicopter Assn. of America meeting. Some introduction is also made in this initial period through the press (AW Dec. 19, 1960, p. 111) and also in an advertising campaign including use of four-color presentations. This initial phase will find the company providing heavy support to operator activities, such as backing association meetings as this one, by supplying samples of the line for the operators to inspect and fly and providing factory personnel to brief operators on the aircraft and outline sales plans. Phase 1 will also see an increase in sales and service clinics sponsored by the helicopter manufacturer, who plans to send teams of three or four factory representatives to each of the eight regions and Canada to visit with operators on their home grounds. Eight demonstrators will be involved in this tour program. Operators will be briefed on sales techniques that can be used to increase their charter business and will be provided with specially designed merchandising kits for use in their local sales campaigns. The approach is expected to provide dual benefits by increasing charter business for operators who will then provide a better market potential for the helicopter, and by stepping up the efficiency of these operators and thereby improving the company's field sales force. This initial phase will be hit hardest by the factory in the five-month period from January through May.

• **Phase 2**, from May through September, will emphasize consumer sales—hitting corporations, individual businessmen and governments. Much of this effort will be directed toward follow-ups on inquiries resulting from promotion of new models made early in the year.

It is in this area that Jose sees the greatest rate-of-growth possibilities, since it is the market that has previously not been worked very hard because of earlier resistance based on lack of information as to a helicopter's usefulness in business. Although this area has shown slow growth over the years, there now are a respectable number of helicopters used in business on which Bell hopes to capitalize to broaden this market.

Total Usage

Statistics gathered by the Bell sales department indicate there are now 162 helicopters used by companies and individuals for business flying. In addition, there are 323 commercial helicopter operators in the U. S. and Canada who currently have an inventory of 964 helicopters. This quantity is equiva-

Commercial Helicopter Pilots

(As of Jan. 1, 1960)

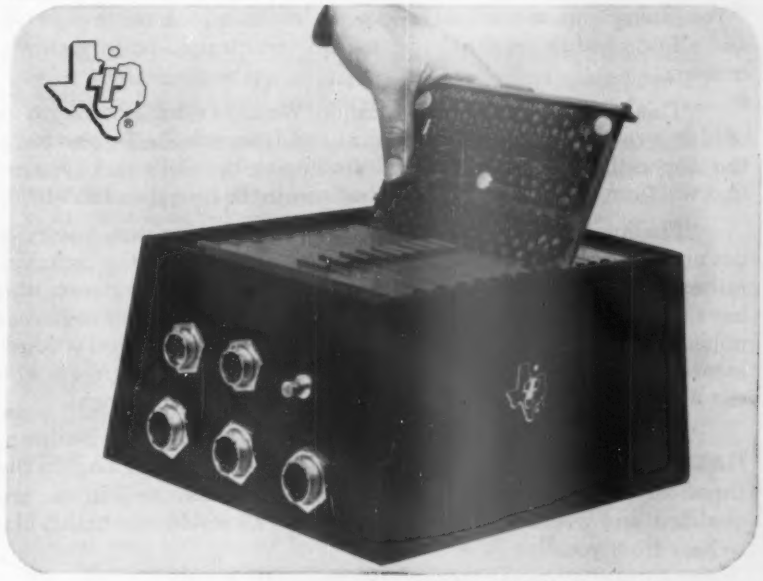
Commercial helicopter and commercial aircraft	6,039
Commercial helicopter	126
Commercial helicopter and private aircraft	68
Commercial helicopter, commercial aircraft and commercial glider	64
Commercial helicopter, commercial aircraft, and commercial autogiro	6
Commercial helicopter, commercial aircraft and commercial glider	3
Total commercial helicopter pilots	6,576

(Data from Federal Aviation Agency, Statistics Division).

Commercial Helicopter Usage

Commercial contract operations (includes petroleum, construction, agriculture, ranching, utilities, mining and air taxi)	683
Executive transport (corporate)	134
Air carrier	23
State and federal agencies	96
Private (estimated)	28

Note: In above tabulation, executive transports and private should be grouped together, providing total of 162 helicopters used in business flying. Above listing shows machines by registered ownership.



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James G. Bowser

Director, Technical and Research Staff

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- **ELECTRONIC SYSTEMS**—conceptual design and evaluation of advanced systems. Of significant interest at this time are high resolution techniques, missile detection and guidance, analytical studies of new communication systems.
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- **INFORMATION THEORY**—as applied to communications, guidance or radar systems with emphasis on information theory, information processing, statistical theory of communications, decision theory, optimum coding and detection.
- **INERTIAL GUIDANCE**—conceptual and analytical investigation of advanced inertial guidance systems. Experience should be in modern weapons systems with emphasis on systems analysis for employment of inertial guidance techniques, and/or conception and design of all or major portions of inertial guidance components.
- **GROUND SUPPORT EQUIPMENT CONCEPT AND DEVELOPMENT**—emphasis on mobile missile systems analysis. Backgrounds in missile and equipment handling, servicing equipment development, transport and transport vehicle evaluation, soil mechanics, hard based installations, and power generation systems are applicable. Experience with military logistics and tactical military operations highly desirable.

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lent to 40% of the U. S. Army rotary-wing inventory, or 130% of the Navy inventory, or 300% of the USAF inventory and represents a respectable base of "exposure" to provide ammunition on the utility of civil helicopters. Indications are that these operators are cumulatively generating between $30-million and $50-million worth of charter business annually.

Total production of commercial and military Bell model helicopters, including those built under licenses, has been more than 3,000 units in the period 1946-1960, the company reports. It is interesting to note that the major developments in this Model 47-series helicopter have been financed with little government contract—the entire Bell H-13 military series has been developed using company funds except for one research and development contract for metal blades totaling less than $200,000, Bell said.

Executive Helicopters

Much of the effort here will be spent on current users of fixed-wing aircraft, since these operators already are sold on the benefits of the airplane for private business transportation. The company will develop studies showing effectiveness of helicopters for everyday business travel, feeling that there is a considerable need for a machine that can serve for trips of 200 mi.—and that many of these trips can be handled more effectively by a helicopter rather than an airplane.

The approach will be that the businessman would not have to get rid of his fixed-wing airplane, but that probably a helicopter can be added to the fleet to better round out his transportation capabilities.

Much work will also be done in convincing this market potential that a helicopter does not require extraordinary flight skills—a mission that Jose feels is necessary because of general feelings engendered by hearsay information gained of earlier helicopters that indicated that three arms and three legs were necessary equipment to handle one of these machines. Emphasis will be placed on developments that have simplified handling and improved flight characteristics of rotary-wing aircraft so that learning to fly and solo in these craft is not so difficult a task. As Jose pointed out, people have soloed in Bell helicopters after five to nine hours and obtained their licenses in 25 hr.

The company also notes that several company executives now are rated helicopter pilots and fly their private helicopters on business trips. Among these are Dan Parker, Jr., president, Parker Pen Co., Harry H. Holly, president of Hollymatic Corp., Joseph Riley, president of Radio Materials Co., and Robert Galvin, president, Motorola. Holly,

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The main point is, RCA West Coast does not believe an engineer's creative abilities fit a specific pattern. Some of our engineers are conformists. Some are not. Some are individualists. Some are not. But *these* prime creative qualities they all share—courage, competence, optimism, and the ability to work together as a team. Solving difficult engineering problems. Right now we're looking for these able additions to this group:

Advanced Systems Engineers, Development and Design Engineers, and Project Engineers, with experience in these areas: Electronic Countermeasures, Data Processing and Computer Systems, and Missile Ground Support Systems.

Interested in the brightness of your future at RCA West Coast? If so, check the box at the right.

RCA
WEST COAST

Call collect or write:
Mr. O. S. Knox
EMpire 4-6485
8500 Balboa Blvd.
Dept. 561-B
Van Nuys, California

RADIO CORPORATION OF AMERICA
WEST COAST MISSILE AND SURFACE RADAR DIVISION

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EQUAL JOB OPPORTUNITY For All Qualified Applicants

SPECIFIC OPENINGS AT RCA WEST COAST ARE:

SENIOR COMPUTER SYSTEMS ENGINEERS
To lead studies in new organizational concepts, pattern recognition and machine learning. Will be a member of high level Research and Development team working on RCA Sponsored Programs.

SENIOR COMPUTER ENGINEERS
To lead applied research studies on kilomegacycle computer circuits. Will work with advanced R & D team.

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For design and application of digital data processing equipment to military systems. Also for conceptual design, synthesis, and analysis of military systems utilizing digital techniques.

ECM ENGINEERS
For project equipment utilizing new and unique high frequency and video circuit techniques.

SYSTEMS OPTIMIZATION ENGINEERS
For application of operation analysis and other analytical techniques. Advanced degree.

OPERATIONS ANALYSTS
For development of large scale systems concepts. Familiarity with logical and/or mathematical models for data processing systems necessary. Advanced degree in Mathematics preferred.

DESIGN AND DEVELOPMENT ENGINEERS
For control equipment, display equipment, and design of analog and display circuits.

SENIOR LOGIC DESIGN ENGINEERS
To design entire computer systems. Advanced degree preferred.

SENIOR ENGINEERS
For relay logic and relay switching design and application to advanced digital techniques.

PROJECT ENGINEERS
For technical project management of development and design engineering and customer liaison and manufacturing. Responsibilities include project direction, control and proposals for improvement and extension of digital system capabilities.

PROJECT ENGINEERS
For visual data handling and analog data processing, employing direct view storage techniques, alphanumeric readout devices and projection systems.

For complete details on these positions contact Mr. O. S. Knox at RCA West Coast.

who uses a chartered helicopter, plans to buy his own Bell shortly.

A third phase of the new sales campaign will begin next fall and will be primarily a cleanup of the earlier portions of the campaign in addition to a continuation of the "hard sell" activities of Phase 2. This is the time of year when many industry conventions take place and Bell hopes to cover these with its sales force. The company has expanded its commercial sales force considerably and it now represents approximately four times as many as the three men it had handling these missions only four years ago.

PITCAIRN AC-35 prototype shown above is on display at National Air Museum.

Indiana Firm Buys Pitcairn Rights

Skyway Engineering Company, Inc., has purchased license rights of the Pitcairn AC-35 roadable autogiro from Autogiro Company of America, Philadelphia, Pa. The aircraft will be built at Carmel, Ind., Skyway says.

Price, which will be determined by available production facilities, will range between $10,000 and $15,000. Anticipating a 15-month trial period before certification, Clayton B. Voege, president of Skyway Engineering, forecasts delivery of the first model in late 1962 or early 1963.

Built, flown and tested extensively prior to 1943, further development and certification of the AC-35 was interrupted by World War II and the prototype model was turned over to the National Air Museum in Washington, D.C.

While retaining the design features of the early model, the new AC-35 expects to reap the benefits of higher cruising speed, greater rate of climb and better jump takeoff by the replacement of the earlier engine with the 135-hp. Lycoming O-290-D2B. Gross weight is 1,400 lb.

Other changes contemplated in the new model include a new rotor blade of the extruded spar, honeycomb filler, metal variety model made by Prewitt Aircraft Co., Clifton Heights, Pa. and the Parsons Corp., Aircraft Div., Traverse City, Mich. and a new hydraulic rotation drive for pre-rotation of the rotor blades and power shaft to the rear wheel.

Non-powered, freely revolving rotor blades fold back over the tail section for easy parking and storage.

Transition from flight to road travel is accomplished by the activation of an "in-and-out" dog lever which disengages the propeller and the turning of a hydraulic lever transferring power to the hydraulic motor for power to the rear wheel. Steering is accomplished through the castered main landing wheels. Auxiliary equipment will be available for special operational purposes such as crop dusting or sign towing, and floats or ski-type landing gear can be installed by factory modification.

PRIVATE LINES

Michigan Aviation Trades Assn. has been formed to promote aviation business and regulation policies. President is Ed McReady, of Northern Air, Grand Rapids, Mich. Secretary is Dick Ward, Ward Aero Service, Three Rivers.

Piper Aztec twin has been presented to African Research Foundation by the Arthur M. Godfrey Foundation. Plane was flown to Nairobi, Kenya, by Max Conrad. Aircraft Radio Corp. donated communications equipment.

Pressurized On Mark B-26 conversion (AW Jan. 30, p. 113) has received its Federal Aviation Agency supplemental type certificate.

New series of high-frequency business aircraft transceivers has been developed by Pantronics Corp., Ft. Lauderdale, Fla. Models are 10-channel crystal-controlled units having 50-watt transmitter output power.

EMPLOYMENT OPPORTUNITIES

NATIONAL COVERAGE

The Advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, manual, etc.

Positions Vacant | **Civil Service Opportunities** | **Employment Agencies**
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The advertising rate is $52.40 per inch for all advertising appearing on other than a contract basis. Frequency rates quoted on request.

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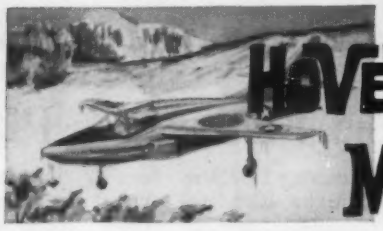

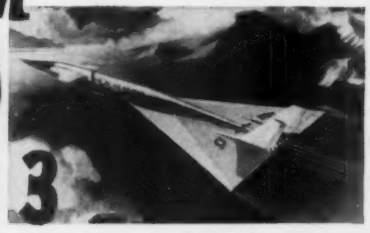

The CJ-805 for the Convair 880...T-58 turboshaft for helicopters and VTOL aircraft...J-79 for the B-58 *Hustler*...these are only a few of the achievements of General Electric's Flight Propulsion Division.

Current projects, both military and commercial, are aimed at creating next-generation systems throughout the power spectrum of turboshaft and turbojet engines – for unusual lift fan systems for VTOL/STOL to the J-93 for the world's first Mach 3 bomber, the B-70 *Valkyrie*.

Experienced ME's and AE's are invited to inquire about the excellent positions now available in the following areas:

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CONTROLS & ACCESSORIES – design and development of electromechanical control devices and systems, gears, linkages, cams, servos, etc. (3-8 years experience).

PERFORMANCE ANALYSIS – plan engine and component tests on statistical basis, issue performance test project sheets, analyze test data (3 or more years experience).

Write informally, or forward your resume in professional confidence to: Mr. Mark Peters, Dept. 64-WF

FLIGHT PROPULSION DIVISION

GENERAL ELECTRIC

CINCINNATI 15, OHIO

ADDRESS BOX NO. REPLIES TO: Box No. Classified Adv. Div. of this publication. Send to office nearest you.
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CHICAGO 11: 520 N. Michigan Ave.
SAN FRANCISCO 11: 255 California St.

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SELLING OPPORTUNITY WANTED

Manufacturers Rep covering N. Y., Pa., & N. Jersey on aircraft, missiles, electronics wants additional unrelated items such as hardware, pumps, switches, valves, etc., RA-6073, Aviation Week.

SPECIAL SERVICES

Experienced, employed corporation pilot will advise you on equipment limitations, cost, crew standards, pros and cons of corporation aircraft. Am not a salesman. SS-6088, Aviation Week.

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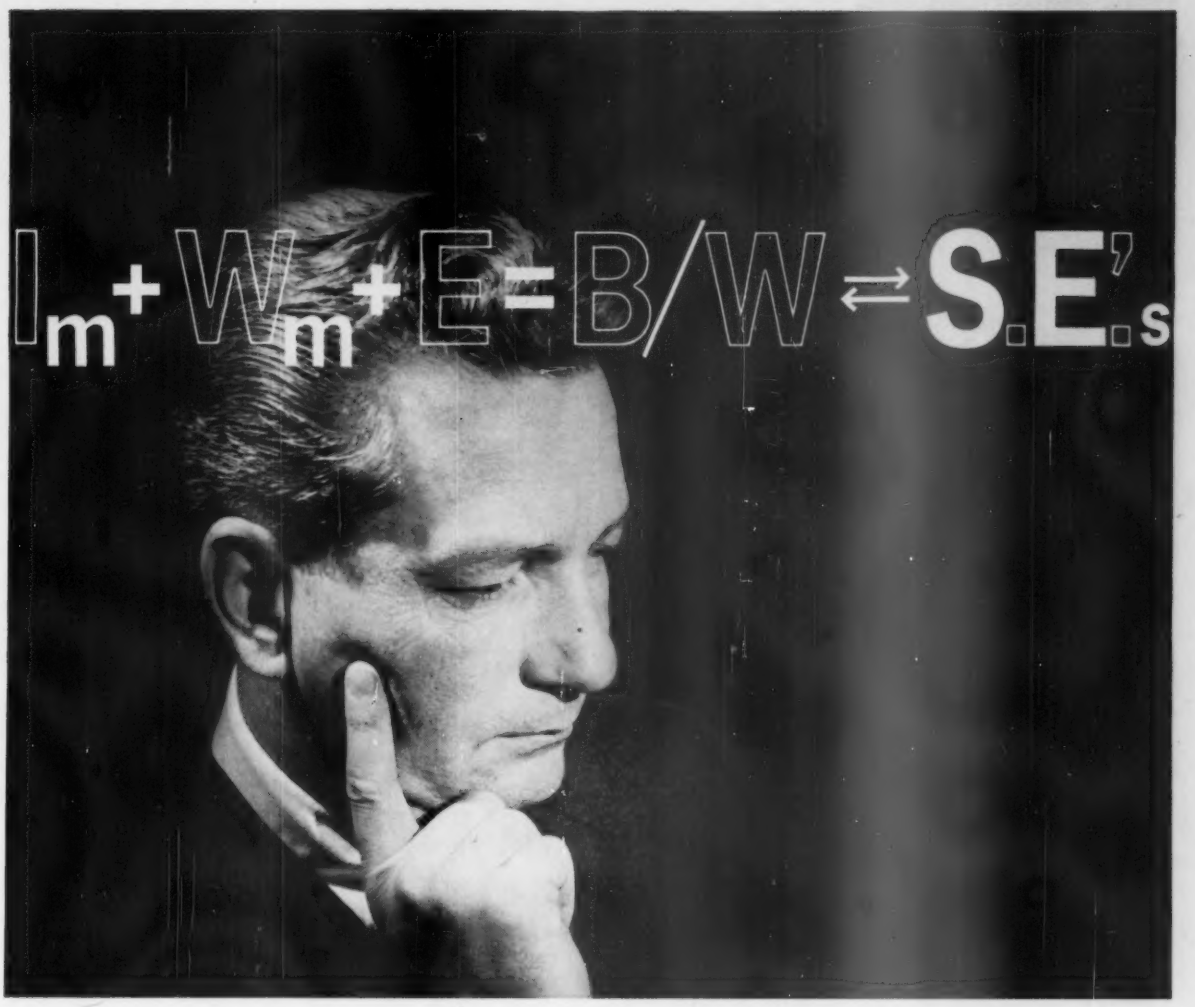


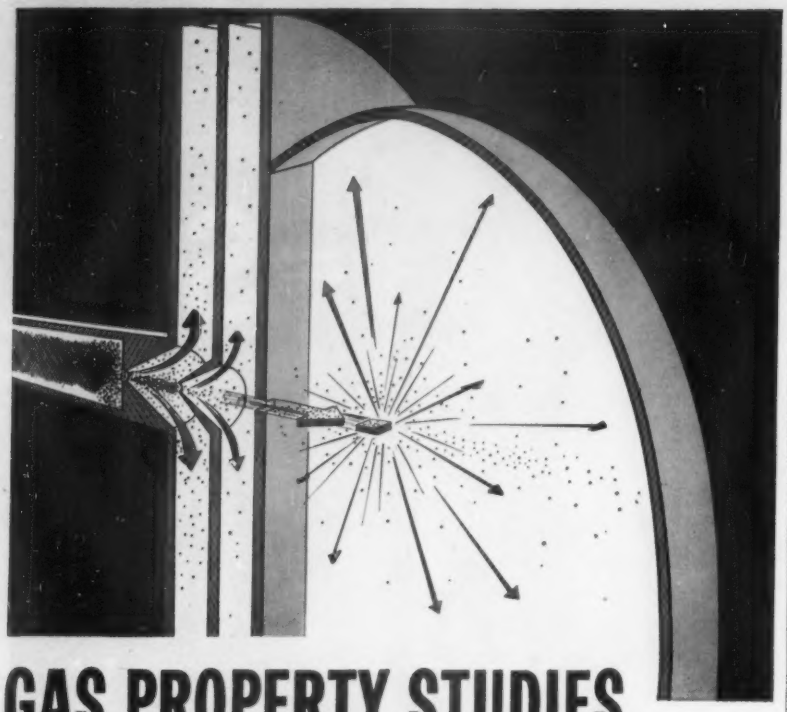
Please permit us a very free translation of the above equation. It's "Maximum imagination plus maximum energy plus experience equals, Boeing/Wichita's requirements for experienced **structural** design, test and research **engineers.**"

To pinpoint it further, we have immediate requirements for Structural Engineers with experience in design adapted to high performance; Dynamics Engineers to work on theoretical flutter and loads analysis; Weights Engineers to maintain close control of airplane limits and tolerances on weight and balance; and Stress Engineers to conduct research on load, stress, and fatigue analysis.

If you would like complete details about working facilities, company benefits, and living conditions in Wichita, write Mr. Melvin Vobach, Dept. **C-21,** Boeing Airplane Company, Wichita 1, Kansas. He will answer you promptly, and in complete confidence.

Boeing/Wichita also needs Design, Test, and Research Engineers in aerodynamics, electrical-electronics, and flight test. If you're qualified in one of these categories, write Mr. Vobach for details.

BOEING/WICHITA



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BY MOLECULAR BEAM

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of Cornell University

J. V. Rentschler
CORNELL AERONAUTICAL LABORATORY, INC.
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MB

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P-6096, Aviation Week
Class. Adv. Div.,
P. O. Box 12, N. Y. 36, N. Y.

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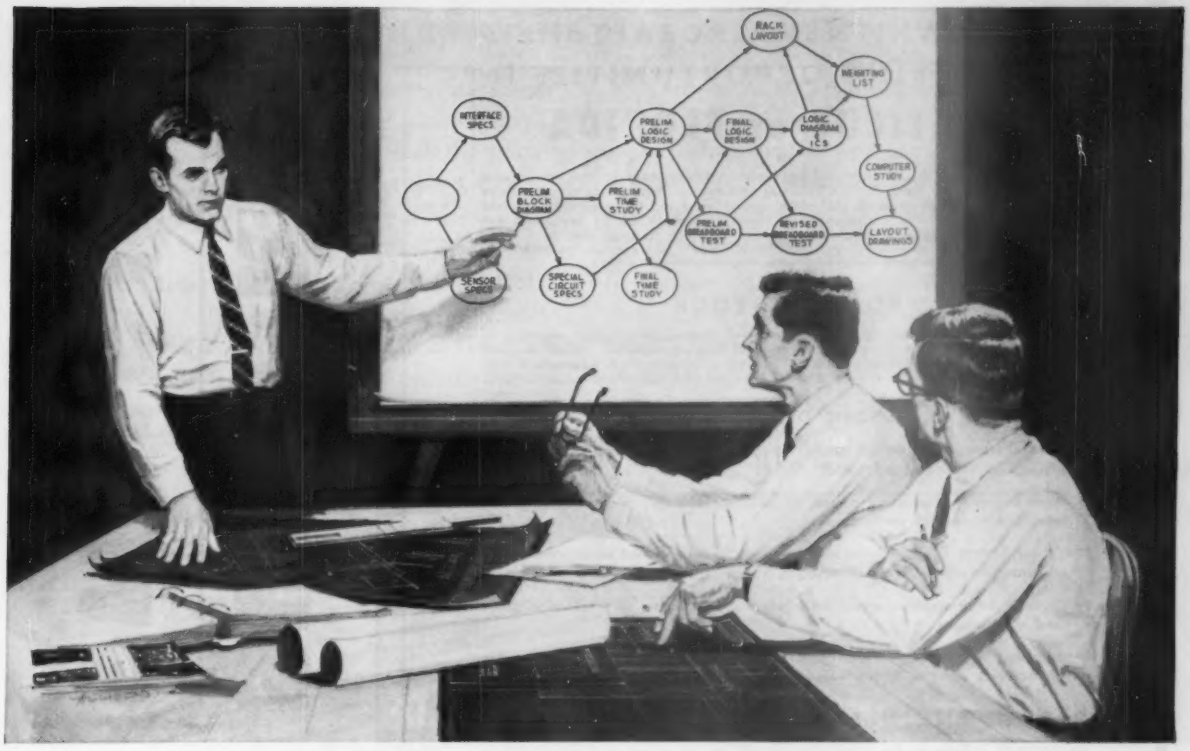

PROGRAM MANAGEMENT STARTS WITH THE DESIGN ENGINEER—AT LIGHT MILITARY*

ENGINEERING PLANNING, time estimates and evaluations were once conducted almost exclusively at the management level, and deadline assignments *passed down to design engineers*. The result: bottleneck delays and unrealistic completion dates.

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Based on initial time estimates and subsequent progress reports—both submitted by engineers doing the actual work at each stage—PERT formalizes all related steps toward a program's completion into an analytical network. Computer analysis then provides both a diagnostic and prognostic means for combining time, talent and resources to assure a high probability of success in meeting overall deadlines.

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All replies will be handled promptly and in complete confidence.

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— OR —

MR. J. W. MORTON, OFFICE 71
WEST PALM BEACH
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DIVISION OF UNITED AIRCRAFT CORPORATION
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Classified Advertising Division

AVIATION WEEK

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Engineers

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For a prompt reply, write in strict confidence to Mr. E. A. Smith, Box 2-B.

DSD DEFENSE SYSTEMS DEPARTMENT
A Department of the Defense Electronics Division

GENERAL ELECTRIC

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Melbourne, Florida, Contact: L. P. Clark, Jr. Director Public Relations.

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DC-3 Cowling for PW 1830-94. Tired but serviceable. $375 for both sides, FOB Toledo, Ohio. Phone UN 5-3311, or write J. Marinelli, Willys Motors Hangar, Toledo Express Airport, Swanton, Ohio.

11 Pass. Dove model 5A, on feeder system, for sale or lease, Geo. Mustin, 1030 Irving St., S. F., Calif.

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For Sale—Howard Super Ventura. One year since manufacture. FS-5963, Aviation Week.

For Sale—Executive Dehavilland Dove. Low time—All mods complete—New Interior—Exterior. FS-5962, Aviation Week.

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c/o AVIATION WEEK

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Your requirements will be brought promptly to the attention of the equipment dealers advertising in this section. You will receive replies directly from them.

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c/o AVIATION WEEK

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CITY 2/6/61

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You are invited to contact **Mr. W. D. Walsh,** Personnel Department

RESEARCH LABORATORIES
UNITED AIRCRAFT CORPORATION
400 Main Street, East Hartford 8, Conn.

LETTERS

Space Medicine

AVIATION WEEK is a magazine of new ideas, therefore I would like to present some new food for thought. Aviation is the mother of space technology, and space technology will bring to life many wonders of the future.

Your magazine was first to predict the flight of the Soviet satellite that found America off guard and sleeping.

The day will come when the readers of this magazine will see space medicine develop life-prolonging medicines for space pilots. These medicines will lead to other medicines that will allow man to live to an age of one thousand years or longer without aging. Now I am talking of medicines that allow man to live a normal life, not in some kind of suspended animation.

I would ask the editors to keep a watchful eye open for research in this field because it will change the life of man to come forever. It will change his religion and his philosophy.

It will allow him time to become educated in many fields of endeavor and to conquer undreamed of horizons of our universe. Over-population will become a problem but it will anyway.

FRED VOLZ
Test Engineer
United Testing Laboratories
Monterey Park, Calif.

Federal Subsidies

A supersonic transport program using federal funds, which you advocate in your Nov. 14 issue, would be a major step in the direction of socialization of developments intended for commercial purposes. This tendency is already dangerously prevalent and, in addition to the unwarranted financial burden it places on the taxpayer to support functions not properly those of government, I believe it is undermining the traditional initiative of American industry.

If a supersonic transport is economically sound and desirable for airline use, its development can and should be undertaken using private capital. If government funding is necessary to bring such a transport into being, then I suggest that there is questionable prestige value in an uneconomical program which is transparently for propaganda purposes.

I feel that the United States can earn real respect abroad through non-military engineering achievements only if these are accomplished in accordance with the traditional operation of American free enterprise.

Government force-feeding and socialization of developments such as supersonic transports and communication satellites will prove only what can be accomplished by adopting the system of our Communist rivals. It also negates industry's ability and destroys its self-confidence through the control exercised by the "technical bureaucracy" which your publication rightly criticizes.

DONALD D. WILLIAMS
Inglewood, Calif.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Miles M.68

With reference to the STAR-Lift system of pre-loaded modular containers for cargo aircraft (AW Nov. 14, p. 41), this idea is even older than the Fairchild XC-120 of 1950 cited in your article.

In 1946, Miles Aircraft of Woodley, England, designed and developed the M.68 freighter which used the modular principle, although they called it by the less esoteric name of a "detachable packing case" (AW Sept. 29, 1947, p. 22).

The Miles M.68 was essentially a four-engine development of the twin-engine M.57 Aerovan and had the same pod-and-boom fuselage layout. After landing, the center portion of the pod was removed and the aft section fairing relocated immediately behind the nose section, which contained the flight deck, so that the aircraft could take off again.

First flight was Aug. 22, 1947, and the pilot was the chief designer, George H. Miles. The following month it was demonstrated in the SBAC Display at Radlett, bearing the registration letters G-AJJM (JJM being the initials of F. G. Miles' son, Jeremy).

The M.68 was described and illustrated in the September, 1947, (final) issue of the Miles Aircraft Works Magazine and in the 1948 edition of Jane's All the World's Aircraft. Nothing came of this interesting design because of the financial difficulties which beset the company around this time, but it evidently has continued to provide food for thought up to 14 years afterward.

DAVID W. H. GODFREY
Montreal, Canada

USAF Defended

I just read the letter from Paul Lindgren of Lindgren, Lupton and Associates (AW Jan. 16, p. 136). I don't know whether to laugh or rage. His charges against the USAF are just too much. He says that the Air Force plans to control first the armed forces and then the economy "in order to implement their pre-emptive war strategy?" Really, now, what have we been smoking? This view of the operation of our Air Force, or our armed forces in total, is pure party line from Moscow via Peiping. It belongs, along with Alice in Wonderland and other such fantasy, in a box separating it from rational thought.

Sure, the USAF supports a unified service with mission-oriented commands, but under the control of the executive branch of the government, not USAF.

Control the economy? Just how is the Air Force supposed to do that, may I ask? Perhaps they will draft Congress into the ranks and then order the congressmen to legislate control of the economy into the hands of the Air Force.

Pre-emptive war? This is contrary to U. S. public opinion, official policy, and USAF doctrine. Air Force organization, indoctrination, weaponry, training, and practiced tactics are all oriented toward strategic deterrence, if not for moral reasons then for the reason that every USAF officer knows full well that pre-emptive war is not strategy, but suicide.

If Mr. Lindgren has any evidence to support his charges, he had better make it known to the public before we are all swallowed up by this demon air force. Meanwhile I shall continue to cherish the illusion that USAF is dedicated in the main to national survival and sovereignty and not to war-mongering or dictatorship, as Lindgren (and associates?) seems to think.

JOHN F. RAYFIELD
Sans Associates
Chicago, Ill.

Idlewild Efficiency

In response to the lengthy and unjust attack on New York International Airport appearing in the Nov. 7 issue (p. 146), I doubt the ability of this disappointed traveler to get around on his own very well.

It should be obvious to this passenger that the airlines are growing. The airline traveler always wanted convenient and attractive facilities. Idlewild has given it to him, and it seems to me that the slight inconvenience associated with separate terminals is the lesser of two evils. Imagine cramming every airplane of every airline into one "convenient" terminal that would take care of departures, arrivals, customs, baggage, reservations and ground transportation. This gentleman doesn't seem to realize what severe chaos such concentration would bring. Perhaps the ground facilities at Idlewild are sometimes inefficient, and tipping certainly should be prohibited, but the layout at Idlewild is as efficient as it could possibly be made considering the monumental job it has handling the world's air traffic.

I also can't understand why this passenger had to make things worse for himself by not making up his mind about airline reservations and instead shifting around from one airline to another. I might also add that it is quite easy to walk from National Airlines to American Airlines and back, even though there is no walkway. Eastern Air Lines may have no escalator but the slope of the ramp is gradual, and the climb can be made easily, bags and all, to the departure level.

I don't know whether gripes about airlines and airports come from passengers who expect others to think for them, but I am sure that if there was a little planning on the part of the passenger he would not experience the unfavorable situations I have read. It is about time we stop making the attacks against Idlewild I see so many times on this page and start thinking for ourselves.

STEPHEN W. HENNINGER
Flushing, N. Y.

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Fluoroflex®-T hose, Resistoflex's proprietary Teflon† product, is absolutely unaffected by any fuel, fluid or gas except high-temperature fluorine and the molten alkali metals: it is non-aging, and has virtually *unlimited* shelf and service life. Moreover, the Resistoflex swaged fitting, pioneered and developed by Resistoflex, has been used in millions of Resistoflex hose assemblies, with never a blowoff on record!

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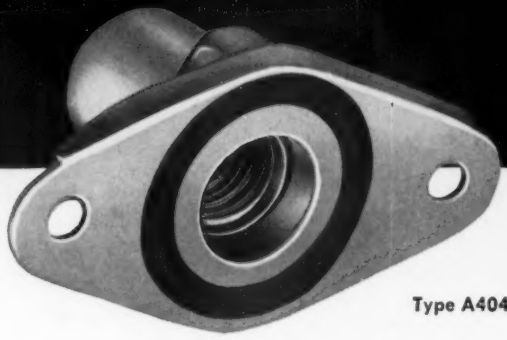
Why this ESNA floating anchor cap seal nut will soon be probing outer space



Type A4040

This Type A4040 floating anchor, base seal, capped nut has been selected to go along on the first manned space flights aboard the National Aeronautics & Space Administration's Astronaut capsule. We can't illustrate this special application as yet, but we can tell you about the unusual performance characteristics of this new design.

Type A4040 is a self-locking anchor nut with a special "0"-ring in the base that provides an hermetic seal to prevent loss of air pressure through seepage along the bolt threads. The stop nut held captive inside the dome provides .020 inch minimum radial floating action to allow quick bolt installation in spite of slight misalignment of bolt holes. It is *100% seal tested* before shipment. The seal is effective whether the bolt is installed or not, and is not destroyed by repeated bolt installations. It will withstand vibration and temperature variations from –70° F. to 400° F.

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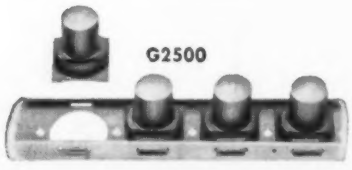

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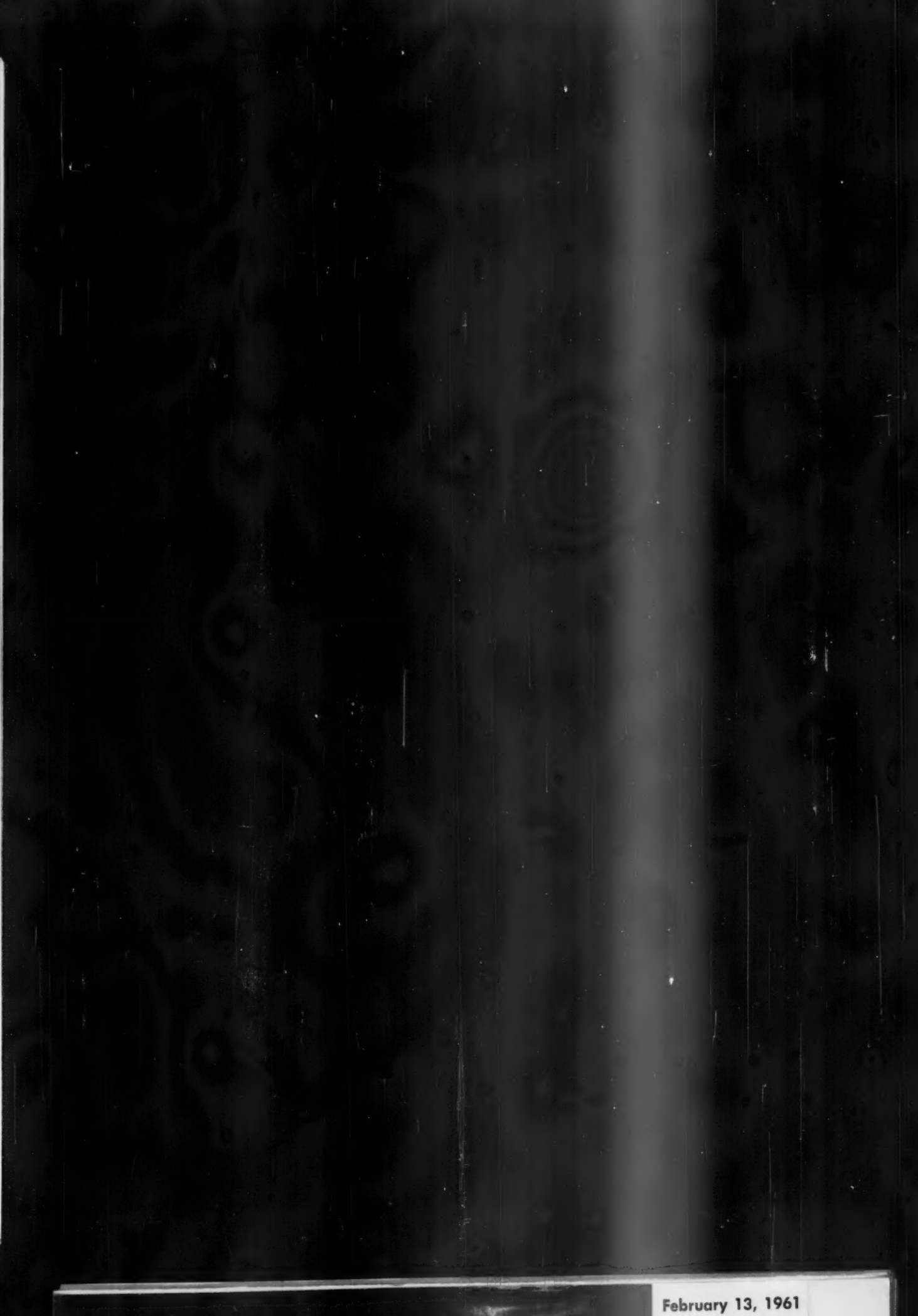

February 13, 1961